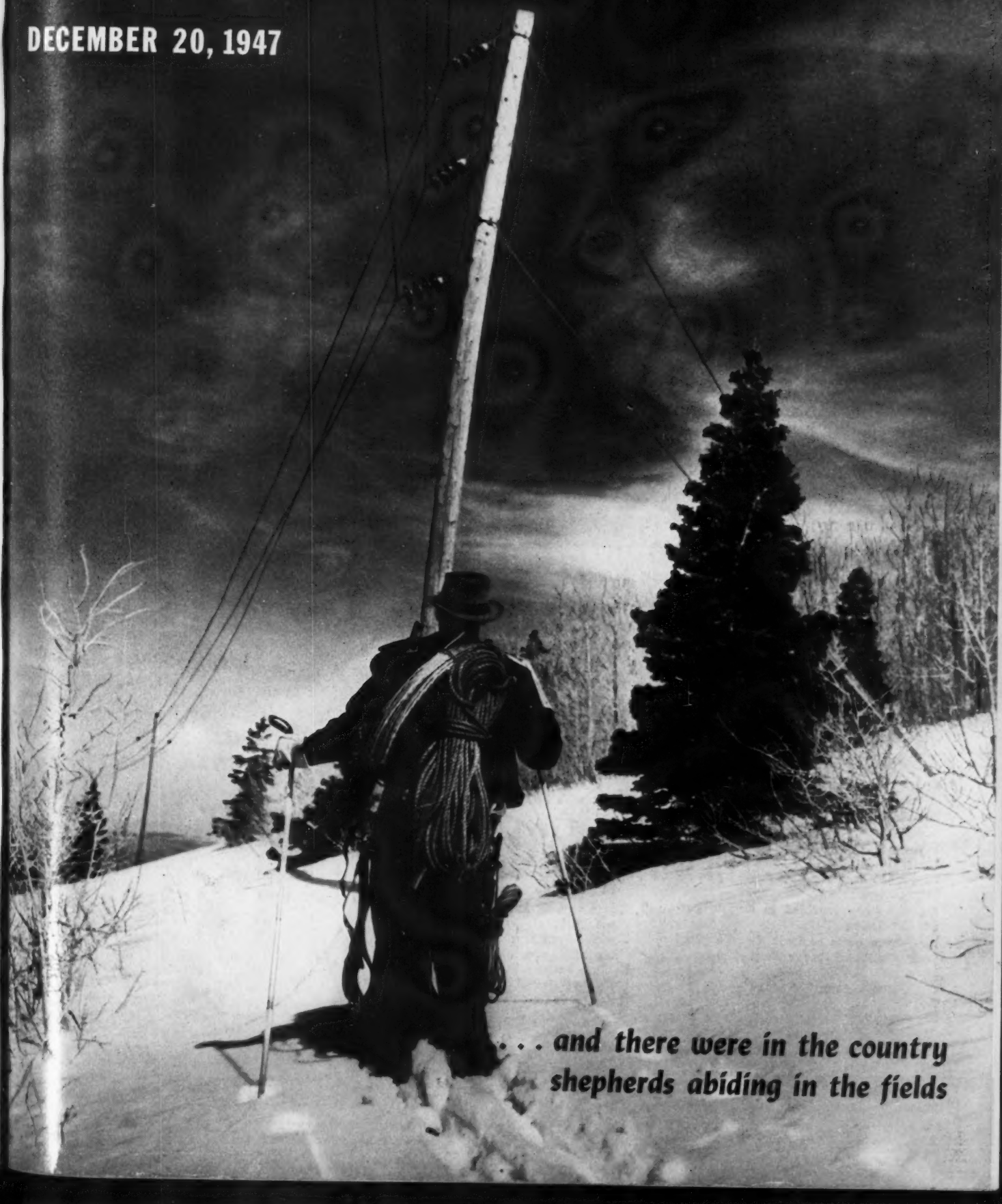
Electrical World

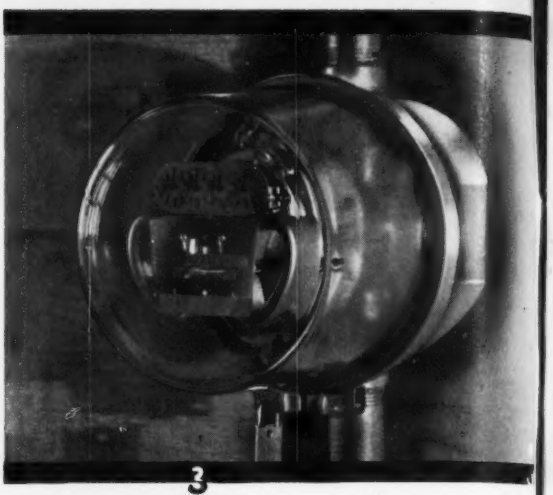
A McGRAW-HILL PUBLICATION

DECEMBER 20, 1947

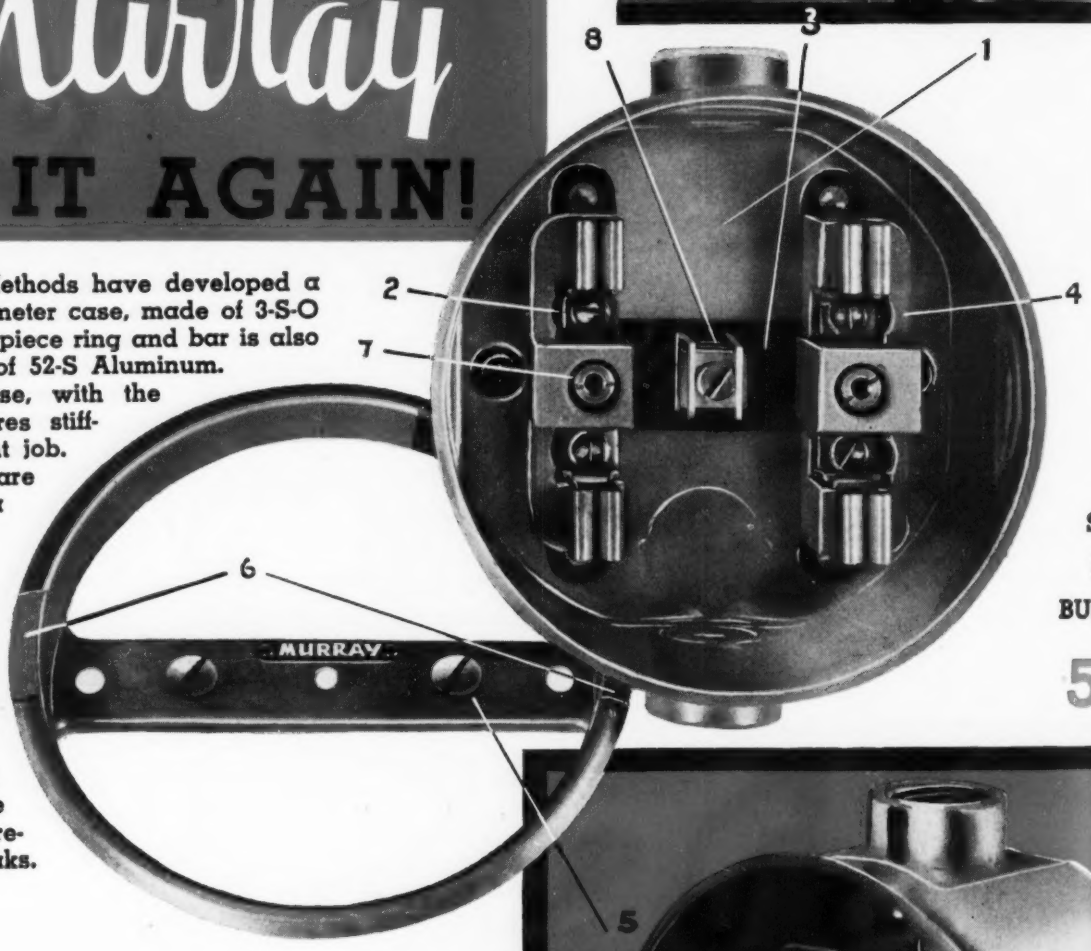


. . . and there were in the country shepherds abiding in the fields

NOW—with ALUMINUM METER SOCKETS



Murray DOES IT AGAIN!

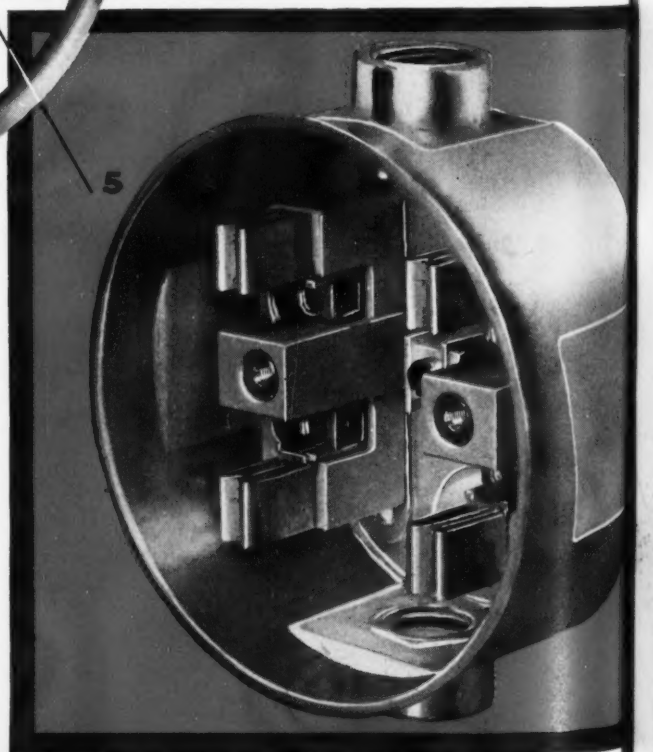


Murray Modern Methods have developed a deep drawn socket meter case, made of 3-S-O Aluminum. The one-piece ring and bar is also deep drawn, made of 52-S Aluminum.

The one-piece case, with the turned-out lip, assures stiffness and a rain-tight job.

Aluminum hubs are specially fitted into a hexagon hole provided in the flat sidewalls. This connection is both rugged and rain-tight because of a special machining operation on the inside of the box. The hexagon-shaped part of the hub on the inside is flared to prevent turning and leaks.

SEND FOR BULLETIN 503



SPECIAL FEATURES

1. Plenty of hand room.
2. Solderless terminals take up to No. 1 wire.
3. Steel spider plate, aluminum-riveted to back of case, holds porcelain and jaws in perfect alignment.
4. Porcelain blocks easily removable by backing out brass screw on top of studs. These studs are anchored in the steel spider plate.
5. Ring and bar easily removable by backing out two screws.
6. Breathers are provided in ring to permit circulation of air.
7. No copper parts come in direct contact with aluminum, preventing electrolytic action.
8. Grounding connection in all cases.

AT THIS TIME ONLY TWO TYPES OF VERTICAL MOUNTED SOCKETS ARE AVAILABLE:

1. Cases with 1" knockout in the back.
   Equipped with a hub at top and bottom.
   Equipped with a hub at top and bottom and one in the right side (three way).
2. Cases without knockout in the back.
   Equipped with a hub at top and bottom.
   Equipped with a hub at top and bottom and one in the right side (three way).

OUTSTANDING CHARACTERISTICS OF 3-S-O ALUMINUM

1. RESISTANCE TO CORROSION
2. WELDABILITY
3. WORKABILITY

METROPOLITAN DEVICE CORPORATION • 1250 ATLANTIC AVENUE • BROOKLYN 16, NEW YORK

Electrical World

FOUNDED IN 1874 • READ BY ELECTRICAL MEN FOR 73 YEARS

GEORGE C TENNEY.....*Acting Editor*

STANLEY A TUCKER....*Managing Editor*
A E KNOWLTON...*Senior Associate Editor*
DANIEL T BRAYMER.....*Associate Editor*
FRANK R INNES.....*Associate Editor*
RICHARD N LARKIN.....*Associate Editor*
N BRUCE BAGGER.....*Assistant Editor*
RUE M SHOOP.....*Assistant Editor*
KENNETH K KOST.....*News Editor*
EDNA M GLENNON..*Assistant News Editor*
BERLON C COOPER...*Lighting Consultant*
WALTER C HESTON...*Pacific Coast Editor*
H S KNOWLTON.....*New England Editor*
JULIUS C MEIER.....*Western Editor*
G A DOYING.....*Mgr. Washington Bureau*
W B WHICHARD *Washington Correspondent*

ECONOMICS DEPARTMENT.....Dexter M Keezer, *Director*, William F Butler, Sanford S Parker, John D Wilson.

WORLD NEWS BUREAUS.....John Chapman, *Director;* London, Paris, Berlin, Moscow, Shanghai, Bombay, Melbourne, Buenos Aires.

DOMESTIC NEWS BUREAUS.....Atlanta, Chicago, Cleveland, Detroit, San Francisco, Houston. Correspondents in 43 principal cities.

RALPH H FLYNN.....*Publisher*
W W GAREY.....*Manager*

DISTRICT MANAGERS.....E F Coffey, New York; N V Palmer, Boston; F P Coyle, Philadelphia; C R Lippold, Cleveland; R R Ream, Detroit; W H Meneilley, Chicago; J T Schaefer, St. Louis.

The contents of this issue are copyrighted and may not be reproduced without the permission of the copyright owners.

December 20, 1947

Contents

Vol. 128, No. 25

This Week's Cover Picture

As Mike Hansen patrols the 44-kv line of the Utah Power and Light Company high in the Wasatch Mountains, he probably does not think of himself as a shepherd. But he and the other guardians of electric power in the generating plants, substations, and dispatching centers this Christmas personify the Biblical herdsmen who watched their flocks in the hills of Judea.

News of the Electrical World 46

Editorials .....45 and 54

Washington Comment 55

Automatic Control Supplanting Supervisory for 2,000,000-Kva System 56
F. I. LAWSON, Pacific Gas & Electric Co

Safety-First in Boom Crane Operations 60

Reliable Simple Steam Plants Cost Less 61
J. A. POWELL and M. J. LOWENBERG, Stone & Webster Corp

Modern Lighting Meets Functional Needs 65
N. H. BOYNTON, General Electric Co

Amplidyne Gives Quick Response on Synchronous Condenser Fields 68
J. H. VIVIAN and F. V. GILLUM, Southern Edison Co

HOW 72

Engineering Reference Sheets.....78 and 80

Load Building 92

New Equipment 98

News About People..... 108

Manufacturers and Markets..... 114

New Electrical Construction..... 116

Recent Rate Changes..... 119

Index of Advertisements..... 124

ELECTRICAL WORLD. Published weekly by McGraw-Hill Publishing Company, Inc. Publication Office, 99-129 North Broadway, Albany 1, N. Y. RETURN POSTAGE GUARANTEED. Editorial and Executive Offices, 330 West 42nd St., New York 18, N. Y. Allow at least ten days for change of address. All communications about subscriptions should be addressed to J. E. Blackburn, Jr., Director of Circulation. James H. McGraw, Founder and Honorary Chairman; James H. McGraw, Jr., President; Curtis W. McGraw, Senior Vice-President and Treasurer; Joseph A. Gerardi, Secretary; Nelson Bond, Director of Advertising; Eugene Duffield, Editorial Assistant to the President. J. E. Blackburn, Jr., Director of Circulation. Subscription rates: Single copy 35 cents. In the United States, $6 a year, $9 for two years, $12 for three years. Canada, $7 for one year, $11 for two years, $14 for three years. (Canadian money at par.) Pan-American countries, $15 for one year, $25 for two years, $30 for three years. All other countries $20 for one year, $30 for two years, $40 for three years. Please indicate position and company connection on all subscription orders. Entered as second-class matter, November 16, 1936, at the Post Office at Albany, N. Y., under the Act of March 3, 1879. Printed in U.S.A. Copyright 1947, by McGraw-Hill Publishing Company, Inc. All Rights Reserved. Cable address MCGRAWHILL, New York. Branch Offices: 520 North Michigan Avenue, Chicago 11, Ill.; 68 Post Street, San Francisco 4; Aldwych House, Aldwych, London, W. C. 2; Atlanta, Ga.; Boston, Cleveland, Detroit, Los Angeles, Philadelphia, Pittsburgh, St. Louis, Washington. Member A.B.P. Member A.B.C.

TRIMMING UNDERGROUND COSTS ...a job where OKOSHEATH PROTECTIVE COVERINGS help you

One of the greatest single cuts proposed in recent years is that if manhole-to-manhole distance can be more than doubled, over-all costs can be halved. How make any such phenomenal saving without changes in cable, splices, ducts and manholes? R. G. Finnerty, of Boston Edison, has explained how. There are less than half as *many* manholes for 1,000-ft pulling lengths as for 450-ft. There are less than half as *many* sections to pull. There are less than half as *many* joints to make and fireproof. Failures and maintenance would be only negligibly different. Thus annual costs probably could be halved.

This is the rough economic justification for cutting the number of manholes. The necessary parallel for the doubling of pulled-cable lengths is found in the value of friction coefficient. Without going into the details Finnerty told the New England distribution engineers, it may be said that 0.3 suffices in many cases where 0.5 has been used. The gain comes from lubrication, well-aligned ducts, careful pulling.

This "Electrical World" editorial of August 30, 1947 suggests the use of longer cable lengths as a means of reducing underground costs. This can be accomplished by lowering the coefficient of friction during the pulling-in operation.

Cost Reduction #1 — For many years, hundreds of thousands of feet of cable (up to 3,000 MCM and 138 kv) with Okosheath Protective Coverings have been playing an important role in trimming underground costs. Now, as suggested in the article, they can give further help. Utilities report reductions in pulling tensions of 25% where Okosheath Protective Coverings have been used and, in consequence, correspondingly longer lengths could readily be installed.

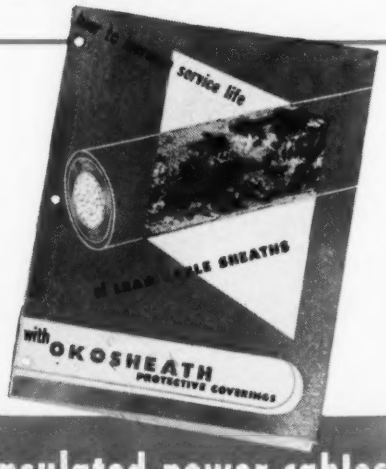
Cost Reduction #2 — Pulling tensions can be reduced even more by taking advantage of the reinforcing properties of Okosheath Protective Coverings and using lead sheaths of less than the AEIC thickness normally required for bare, unprotected lead coverings. Weights are thus reduced and so are cable costs (Reference: Okometal Bulletin OK-1034).

Cost Reduction #3 — The "Electrical World" article states that "failures and maintenance would be only negligibly different." This may be true of bare, unprotected cables, but, where Okosheath Protective Coverings are added, underground costs of this nature are also trimmed because:

(1) Chemical corrosion is prevented
(2) Electrical corrosion is eliminated
(3) Resistance to manhole bending fatigue is increased
(4) The sheath is protected against mechanical damage during installation
(5) The reinforcing properties reduce the effects of expansion from internal pressures
(6) Grading of duct lines for draining purposes is unnecessary.

IF YOU WANT MORE INFORMATION

The diagram above shows the construction of Okosheath Protective Covering, but full details on tests, of long and wide field experience and the answers to many questions asked by engineers are given in Bulletin OK-2046A, just issued. Just ask us for a copy. The Okonite Company, Passaic, N. J.



OKONITE-CALLENDER paper insulated power cables

DECEMBER 20, 1947

. . . And to all, a Good Light

THE LAST TWELVE months haven't been happy ones for the men who operate U. S. power systems. They've had less equipment than they wanted, and a good deal more load than they ever, ordinarily, would have attempted to serve with that capacity. They have seen scheduled installation dates for new equipment come and go—without the equipment. They've put new equipment into operation only to have it fail. Everlastingly, they have seen the loads grow and grow.

For three months, now, capacity has been booming into operation. Much of it was to have been installed months ago. Strikes and material shortages and lowered productivity and priority to non-central-station demands for the same equipment—these and even more factors combined to delay deliveries. Somehow, the loads were met without it. For three months, new capacity installations have been ahead of load growth by as much as 20 percent. This fact has helped minimize the widespread and crippling water shortages.

The fact that the industry has fought its way through 1947 safely enough doesn't mean that all of this year's problems no longer exist. The primary cause of the industry's problem will continue to haunt power systems next year, if the U. S. Department of Commerce is any prophet. Just two weeks ago, Commerce reported that boom conditions will continue next year in almost every industry. No one, least of all the power business, is going to complain about that. If it does continue, the power business will continue to strain.

Where this Christmas does bring real improvement in the industry's prospects is in the matter of new capacity installations. Two months ago, President Oakes, of EEI, reported that new generating equipment is coming on at the rate of 400,000 kw monthly. Next year, he said, capacity should increase by 2,000,000 kw more than load, with a total of 5,000,000 kw installed.

It is encouraging to realize that, without a new wave of strikes such as the U. S. weathered in 1946, production of central station plant should boom along. The first units are out. The order boards are full. Materials flow better.

As parts of the world's strongest electric power industry, U. S. systems are rushing all the plant they can get. This, and their superb operation of existing plant, is the industry's Christmas present to the strongest power-consuming country in the world.

★ ★ NEWS OF THE

High Court Refuses to Open 'Attleboro Gap' for Gas Firms

Supreme Court in 8-0 Decision Permits Indiana to Control Rates for Natural Gas Sold Directly from Interstate Lines to Industries—Scoffs at Gap between Federal-State Control

THE SUPREME COURT refused this week (Dec 15) to open an "Attleboro gap" for natural gas companies.

In an 8-0 decision, it held that states may control rates for natural gas sold directly from interstate pipelines to industrial users. The ruling killed industry contentions that there exists a "blind spot" between state and federal regulation of natural gas similar to the historic "Attleboro gap" which was plugged by the Federal Power Act of 1935.

Permitting the Indiana Public Service Commission to gather data preparatory to setting rates of Panhandle Eastern Pipe Line Co to two industrial plants, the high court held:

1. The states traditionally have regulated rates paid by ultimate local consumers of natural gas.

2. Such state regulation does not interfere with Interstate Commerce as forbidden by the commerce clause of the Constitution, nor does it hamper federal regulation of other pipeline operations as provided by the Natural Gas Act.

The Indiana decision, involving sales by Panhandle to plants of the Anchor-Hocking Glass Corp at Winchester, Ind., and DuPont at Fortville, Ind., resolved a similar test of state regulatory control now pending in the Michigan Supreme Court. The Michigan Public Service Commission also is attempting to start rate proceedings against Panhandle. Several other Midwest states have followed the two cases so closely as to indicate similar intentions.

In affirming an Indiana Supreme Court decision against Panhandle, this week's ruling accepted the company's argument that its direct industrial sales were interstate operations not subject to rate regulation under the Natural Gas Act. The high court pointed out, however, that the courts traditionally had recognized state regulation to direct sales to commercial and residential consumers, and termed Panhandle's sales to DuPont and Anchor-Hocking as "clearly in that category."

Since its interstate operations and sales for resale are subject to federal regulation, Panhandle's direct industrial sales must come under the "effective dual regulation Congress had in mind" when it passed the Gas Act, the Court ruled. "The attractive gap" between state and federal regulation "envisioned" by Panhandle "is a mirage," the Court concluded.

NOT DRAGGING IN THE YULE LOG is this line crew of the Public Service Co of Colorado. They are dragging a pole, to be used for a power line to a new ski lift, through the 11,400-ft Berthoud Pass in the Rockies. The 3,000-ft line will serve the world's first two-seat ski lift

•

Oregon Court Voids Pact between PUD and Co-op

An agreement between the Union County (Oregon) PUD and the Union County Electric Cooperative was ruled void recently by the Oregon Supreme Court because it "involves abdication by the PUD in favor of the REA."

The agreement involved provided that the electric system of the PUD was to be operated in accordance with standards of operation and maintenance established by the REA, which also was to approve the manager selected for the system. This agreement was to be in consideration of a loan by REA to the cooperative for extension of the system.

In its decision the Supreme Court said: "It was not contemplated by the peoples utility district law that the district could transfer the management, responsibility, and control over an electric system to another agency." Such a transfer, the court held, constitutes a "complete surrender or abdication by the district of its statutory authority."

Use of revenues from a bond sale for acquiring property of the California Pacific Utilities Co by the PUD was upheld by the court.

ELECTRICAL WORLD ★ ★

Utility Would Build Plants at Flood Control Projects

Pacific Gas & Electric Co is willing to build all power plants proposed in —and in accordance with—plans of the Corps of Engineers for flood control projects in northern California. Or, if the federal government decides to construct the plants, PG&E will take delivery at the plants of all power generated.

The utility's offer was made in a letter from William G. B. Euler, vice-president and general manager, to the California Water Resources Board, which is holding public hearings in Sacramento on federal appropriations for the fiscal year 1949 for California flood control projects authorized by Congress.

The utility agrees, Euler said, to pay a "fair price" for the use of water through PG&E-constructed plants, or for power delivered by government plants, final decision on such a price—if agreement cannot be reached—to rest with the FPC or the California Public Utilities Commission.

Commenting that for many years PG&E's policy had been in favor of cooperation in the development of public water conservation projects by providing a market for any power generated, Euler declared:

"The benefits of a cooperative power program will accrue to the water users, power consumers, and taxpayers. As regulated by the PUC, the company is allowed to earn only a fair return on its own investment. Any benefits from purchased power must be passed on to consumers."

He pointed out that the amount of power produced as a by-product of water conservation and flood control projects is variable and can be most efficiently utilized when coordinated in a regional power system.

•

Non-Partisan Board OK

The non-partisan board that operates the municipal electric and water plant of Frankfort, Ky., has been approved by the Court of Appeals. Two city councilmen started the suit, claiming that the City Council should have retained more control over the property.

GEORGIA TECH'S new a-c network calculator is under the direction of Herbert P. Peters, at desk in the background. In the foreground, Thomas B. Cresswell, and at the panel, R. O. Loomis, both George Power Co engineers

2 Iowa Co-ops Merge, Plan 15,000-Kw Steam Station

Two Iowa electric cooperatives, among the first to receive federal loans for generating facilities, are merging to form a new "super" co-op. Their successor, the Corn Belt Power Cooperative of Humboldt, already has obtained a Rural Electrification Administration loan to build a 15,000-kw steam generating plant.

Corn Belt also will take over the nine diesel-driven plants of the Federated Cooperative Power Association of Hampton and the Central Electric Federated Cooperative Association, Pocahontas. The latter co-ops received REA loans to build the first of these plants in 1936.

Total capacity of the nine diesel plants is 25,555 kw. Corn Belt plans to devote $2,786,000 of its federal loan of $5,300,000 to construction of the steam plant, which will be located at Humboldt. Another $2,388,000 will be used to erect 310 miles of 69-kv transmission lines and six substations. The new co-op will continue to serve the 11 distribution cooperatives which formed the Central Electric and Federated Co-ops.

Remainder of the REA loan has been allocated for purchases of equipment, office facilities, and miscellaneous expenses—$51,000—and for working capital—$75,000.

The distribution co-ops, which will become members of Corn Belt, report that they are serving 22,545 rural consumers who, in September, 1947, used an average of 169 kwhr of energy monthly. REA loans approved for the 11 co-ops, they stated, will provide for connection of 1,100 additional consumers to their lines.

•

Western Engineers Start Chicago Science Center

The Western Society of Engineers has joined the John Crerar Library in the organization of a Chicago technical and scientific center for the use of professional persons, students, and all others interested in the advancement of science.

The society has leased over 9,000 sq ft of space on three floors in the Taylor Building which adjoins the library on Randolph Street. The society expects to spend about $100,000 to develop the new center.

The library of the society, more than 20,000 books and pamphlets, will be coordinated with the 700,000 volumes of the Crerar Library, the world's largest free public library devoted exclusively to science and technology.

CENTRAL MAINE POWER CO has enlarged its operating "family" by adding members of the crews of the destroyer escorts, *Maloy* and *Foss*, stationed at Portland to supply supplementary power during the drought. Here are the sailors arriving at Augusta to attend a dance sponsored by the CMP Girls Club of Augusta for the benefit of the fire-damaged Cancer Research Laboratory at Bar Harbor

Texas, Arizona-Mexico Interties Okayed by FPC

Early linking of the Southwestern Public Service Co's facilities with integrated systems of northern Texas was provided by an emergency interconnection approved recently (Dec 5) by the Federal Power Commission.

On the same date, Arizona Edison Co was authorized to continue supplying energy to two small Mexican utilities without subjecting the company to federal regulation.

Southwestern Public Service will be linked with Texas Electric Service Co through use of an existing 66-kv connection from Southwestern's Riverview Plant to the Quanah Switching Station of West Texas Utilities Co. The West Texas and Texas Electric systems already are interconnected.

This link will serve as an alternate for the emergency intertie between Southwestern and Texas Electric authorized by FPC last August. The latter, consisting of a 50-mile tie line, has not been completed because of delays in delivery of transformers and other material.

Company engineers estimated that 15,000 to 18,000 kw of energy would be available from Southwestern over the newly authorized intertie upon installation of a new 30,000-kw unit at the Riverview Plant. The Southwestern-West Texas intertie was authorized until March 31, 1949, and an extension of time until the same date was approved for the previously authorized Southwestern-Texas Electric emergency link.

Arizona Edison was authorized to continue use of permanent interconnections with facilities owned by Compania De Servicies De Agua Prieta, S. A., and Alejandro Elias Cass until Dec 31, 1948, or until the Mexican operators can install their own generating capacity, whichever is earlier. Edison previously planned to discontinue service to the Mexican utilities, which serve the border towns of Agua Prieta and Naco, as of Dec 1.

•

Standardization Seminar

For the benefit of companies and individuals having problems concerning the organization of standardization work or the technique of writing standard specifications, a private seminar is being offered by Dr John Gaillard, mechanical engineer on the staff of the American Standards Association. The five-day seminar, Jan 26-30, will be held in the Engineering Societies Building, 29 West 39th St, New York. Registrations should be made at ASA headquarters, 70 East 45th St, New York 17, N. Y.

Rates of Cincinnati Utility Bring Involved Litigation

COLUMBUS, O.—The City of Cincinnati and the Cincinnati Gas & Electric Co were hip deep in litigation last week as the company pressed an appeal for an electric rate increase.

Three cases, involving rate proceedings as old as 1944 and as recent as last week, were before Ohio's Supreme Court and its Public Utilities Commission. The electric case was being heard by the commission this week. They are:

An appeal by the company to the PUC from 1944 and 1946 gas rate cuts.

A petition by the city to the Ohio Supreme Court to nullify a recent temporary gas rate increase.

An appeal by the company to PUC from 1944 and 1946 electric rate cuts.

This line-up of litigation was threatened with complication when the company pressed for a temporary electric rate boost because of delays in settling its appeal from the 1944 and 1946 electric rate cuts.

A city official greeted the temporary electric rate increase proposal with a promise to petition the state high court again for nullification, should the PUC approve the power rate boost, as it did one for gas. City sources previously had contended that it was not the city's fault that appeals from the 1944 and 1946 electric rate cuts were so long delayed. CG&E, they said, had failed to file its inventory on time.

Meanwhile, in Cincinnati, a George J. Weller asserted that if the temporary electric rate boost were granted, advocates of municipal ownership would renew their fight for public acquisition of the system.

In petitioning the Supreme Court for nullification of the temporary gas rate boost, city officials said the PUC had authority to order such an increase only when the company was faced with "economic disaster." This, they insisted, is not the case in Cincinnati.

•

Sho-Me Now a Utility

The Missouri Public Service Commission has approved the reincorporation of the Sho-Me Power Association as a general utility. Court action had forced it to give up its cooperative form of organization. Sho-Me, with general offices at Marshfield, can now continue to serve consumers in south central and southeastern Missouri. The PSC also permitted the Association to continue the same rates which it charged as a co-op.

Management Must Supervise Customer Relations in Field

H. R. Flannegan, Philadelphia Electric, Tells PEA Meter Committee, Talk not Enough—Meter Corrosion Described as Regional Problem—Devices to Speed Reading Revealed

MANAGEMENT SUPPORT of customer relations is "just talk" unless it is backed up by tangible supervision in the field, H. R. Flannegan, Philadelphia Electric Co, told metermen of the Pennsylvania Electric Association in Philadelphia, last week.

Observing that customer relations—either good or bad—result from "the way we do the things we do", Flannegan pointed out that good customer relations have to be built into every employee job. "But," he warned, "a customer relations program must be supervised, if it is to be maintained. This can't be done from a desk. It must be done in the field."

Technical discussion of the PEA Meter Committee centered around such timely topics as meter corrosion, experience with universal demand registers and the metering of large loads.

Consensus was that meter corrosion, while warranting attention, is largely a regional problem. E. H. Tyson, Pennsylvania Power & Light Co, reported that of 68 companies surveyed by the EEI Meter & Service Committee only 8 reported "considerable" meter corrosion and of these, 6 were located on the Pacific Coast. Thirty-two companies in the group had experienced "some" corrosion, but the cases were few and scattered. Corrosion trouble of Pennsylvania companies was, according to Tyson, not more than "normal," and no general preventive measures were warranted.

Presence of corrosion trouble on the Pacific Coast, and its absence on the Atlantic and Gulf Coasts, was explained by G.B.M. Robertson, Philadelphia Electric Co, as due to prevailing westerly winds on the Pacific Coast blowing salt spray inland. Prevailing off-shore winds eliminate the trouble on the Atlantic seaboard, he indicated. There is no protective coating that won't disintegrate under some corrosive conditions, Robertson stated. However, anodizing of aluminum parts will protect against common corrosive conditions.

E. L. Keller disclosed that Duquesne Light Co is experimenting with a meter socket that can be subjected to flood water submersion without destructive corrosion.

R. W. Pfaff, Philadelphia Electric Co, reported the development of a key-operated device for resetting time switches without removing the cover. Its use has relieved meter readers of the need for carrying seals and sealing tools and has resulted in a general speed-up in reading meters and resetting time switches.

While admitting that Swiss and Italian sapphire meter jewels are superior in quality and lower in cost than American substitutes. G.B.M. Robertson suggested a subsidy of American jewel sources. "If we can't get foreign jewels, we are going to have to do something", he said.

Favorable experience with a universal demand register by the Duquesne Light Co was reported by E. L. Keller who revealed that the Pittsburgh company has 20,000 demand registers of a single make, type, style and rating in use on single phase, polyphase, transformer type, and self-contained meter installations. All 20,000 demand registers are Type RW, 1-kw registers with a 300 percent scale. This standardization has brought notable savings in purchasing and stocking of parts and a simplification of records. Use of the same demand scale on all registers has also reduced reading errors, Keller reported. The disadvantage of a multiplying constant for demand readings has been offset by the advantages of having the same register on all demand meters, he said.

Factors of cost and accuracy favor single-tank-type current and potential transformers for metering large loads in the voltage range from 23 to 69 kv according to E. G. Howe, General Electric Co. He conceded, however, that greater flexibility was obtainable at only slightly higher cost and with equal accuracy with individual current and potential transformers.

W. Weinerth, Philadelphia Electric Co, presented a detailed analysis of changes in the new edition of the National Electric Code. Mentioned specifically were clauses permitting use of No. 8 wire on branch circuits serving ranges up to 15 kw in size and a reduction in permissible clearance for service drops above roofs that cannot be walked upon. Weinerth noted that grounding of range frames to neutral conductors is now recognized by code.

METERING DEVICES discussed at PEA Meter Committee meeting absorb the attention of L. J. McMakin, left, Metropolitan Edison Co; E. L. Keller, Duquesne Light Co; E. L. Lundy, Wheeling Electric Co; H. S. Reddig, New Jersey Power & Light Co; and Nelson Yeakel, Philadelphia Electric Co

Energy Production Sets New High in October

Production of energy by electric utilities during October totaled 22,338,103,000 kwhr, according to the Federal Power Commission report. This is the highest monthly production of record, exceeding last October's production by 10.2 percent and exceeding by 2.7 percent the previous high of 21,743,754,000 kwhr produced during August, 1947.

The water power output as a proportion of the total dropped to 24.6 percent compared with 31.1 percent last October.

Industrial production, including generation by railway and railroad plants, was 4,410,145,000 kwhr for October, an increase of 4.8 percent over the same month last year. Combined utility and industrial production during October was 9.5 percent above October, 1946.

R. PAUL SMITH, president of the Potomac Edison Co, clutches a reproduction of the plaque which will be installed in the Williamsport plant of the utility. The plaque carries the new name of the plant, "R. Paul Smith." Standing beside Smith is Earle S. Thompson, president, American Water Works & Electric Co

Higher Executive Wage Level Proposed by Union

Union proposals for raising the salary requirements for administrative, professional, and executive employees exempt from the Wage-Hour law got almost united opposition from management witnesses at hearings being held by Wage-Hour Administrator William R. McComb.

The hearings on the Administrator's proposals for revising the definition of supervisory and professional employees, begun Dec. 2, will continue until Jan. 15.

C. B. Boulet of Edison Electric Institute and representatives of the Engineers and Salaried Employees Association and Utility Coworkers' Association are among the witnesses scheduled to testify on Jan. 8.

The Institute of Cooking and Heating Appliance Manufacturers, through Samuel Dunkel, contended that there is no justification for raising the salary minimum to $500 a month, as proposed by the CIO United Electrical, Radio & Machine Workers in a formal petition to the Administrator. Present salary requirement is $200 a month for administrative and professional employees and $35 a week for executives.

The International Brotherhood of Electrical Workers, AFL, through Lawson Wimberly, assistant to president Dan W. Tracy, suggested that there be no changes in the present regulations except to raise the salary requirements to $100 a week.

Lloyd B. Gruman, representing the Heating, Piping and Air Conditioning Contractors Association, said a $500 minimum salary for exempt workers would hamstring the organizations he spoke for by raising costs far above safe operating limits.

The UE-CIO's arguments were presented by Joseph Dermody, an international representative of the union. When asked whether the union paid time and a half for overtime to its employees, Dermody replied that the union was not a profit-making organization.

•

New Brunswick Power Expropriated by Province

The New Brunswick Electric Power Commission has been granted authority to expropriate the generating and distribution system of the New Brunswick Power Co. In making the announcement, Premier J. B. McNair said the Commission will enter into possession of its new holdings "at the earliest possible moment."

Nothing was disclosed as the price the utility will receive for its holdings. It is assumed that a price will be set after an appraisal has been made. The government's authority to expropriate is provided for by provincial statute.

No Power Shortage But No Street Lighting

Scottsville, Ky., was without street lighting last week. The Tri-County Electric Membership Corporation, Lafayette, Tenn., has plenty of power available. But it wants Scottsville to pay the $2,550 which it claims the city owes for power used during the past 30 months for street lighting and water pumping. The City Council wants to pay the bill, but the mayor doesn't. Council has gone to court to compel the mayor and city clerk to issue a voucher and check.

House Votes Reclamation Additional Appropriations

Supplemental appropriations for Bureau of Reclamation construction work zipped through Congress this week during the closing hours of the special session.

Additional funds for the Bureau were assured Dec. 16, when the House Appropriations Committee lumped them into the third supplemental appropriation bill, together with funds for interim aid to Europe. European aid was the primary "must" legislation of the special session.

House committee action on the Reclamation request approached record speed. Late last week, the Budget Bureau submitted a proposal that a total of $29,375,000 be granted for four Reclamation projects. The House group immediately screened the request, which had been reduced by the Budget Bureau from some $40,000,000 sought by Reclamation. The committee added a total of $2,564,000 for two projects and sent the measure to the House floor early this week. The House passed the entire supplemental bill Dec. 17.

Funds added by the House committee boosted Budget Bureau estimates for the Columbia Basin project from $11,725,000 to $13,584,000, and for the Central Valley project from $10,700,000 to $11,405,000. The Reclamation Bureau originally sought $15,000,000 for each project.

In addition, the committee approved Budget Bureau requests of $4,150,000 for the Colorado-Big Thompson project and $2,800,000 for Davis Dam in Arizona.

•

Municipal Finally Quits; Utility Will Supply Power

High operating costs have brought victory to the Georgia Power Co in Sandersville, Ga. For 47 years the city has been operating its own power plant. On an average of every ten years additional or larger engines and generators have been installed. Last year a 600-kw diesel was installed.

However, the plant could not keep up with demand. During the last fiscal year, the city paid Georgia Power $20,000 for extra power. Now city officials have signed a five-year contract for electricity with the utility. The municipal plant, now $70,000 in debt, will be shut down but kept available for emergencies.

City officials claimed rising fuel costs (the city plant uses both coal and oil) have made it expedient to close the plant. Several years ago a plan to close the plant was defeated in an election.

Industrial Sales Excellent Now, Will Get Even Better

Prospects for the sale of industrial power not only continue excellent but the industry hasn't begun to approach the demand of the future, Frank Gaskill, sales manager, Philadelphia Electric Co, told the Interstate Power Club of New York, Monday, in New York City.

He pointed out one industrial application after another, some in general use now, others that will be installed rapidly as time goes by. In every case the demand for power will increase as larger and more units are installed.

Charles C. Doyle, J. E. Doyle Co, Cleveland, demonstrated one of the infra-red heating units of his company. He pointed out the many applications of such units, especially in the printing and textile industries.

The problems of high-bay industrial lighting were described by S. G. Hibben, Westinghouse Electric Corp. He stressed the importance of not only getting a good installation but of getting one that can be maintained at low cost. Slides were used to illustrate industrial installations using both mercury-arc and incandescent lights in combination.

L. V. Armstrong, Ingersoll-Rand Co, warned against misapplication of diesel power. This he considered as important as correctly applying diesel power. He pointed out that utilities and manufacturers of diesel equipment have a community of interests.

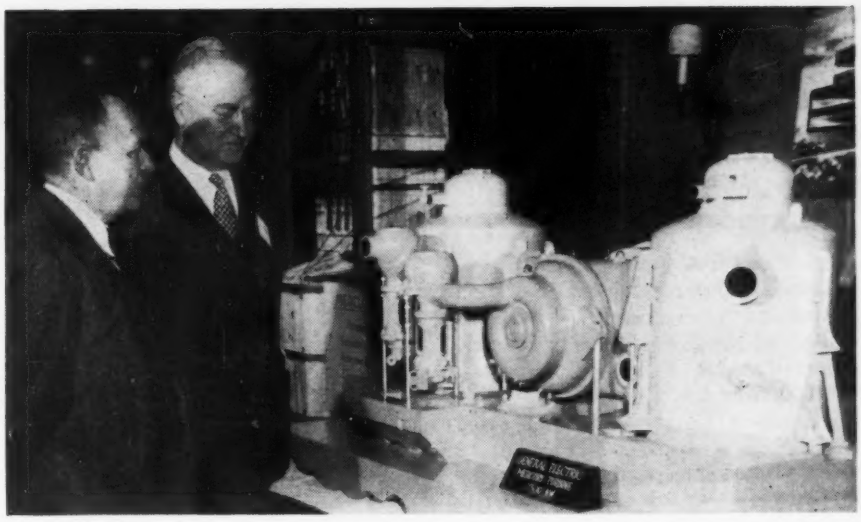
J. V. Gallagher, Jersey Central Power & Light Co, was elected chairman, and W. L. Ellis, Public Service Electric & Gas Co, Newark, N. J., vice-chairman. Directors elected are W. C. Pierce, Delaware Power & Light Co; J. B. Taylor, Atlantic City Electric Co; J. H. Coates, Ebasco Services, Inc; C. R. Turner, United Illuminating Co; Clarence Shoch, Pennsylvania Power & Light Co.

•

Metropolitan Edison Cited for Secret Rate Increase

Metropolitan Edison Co., Reading, has been cited by the Pennsylvania Public Utility Commission for alleged failure to disclose in a 1946 contract that rates it charged for power furnished Edison Light & Power Co., York, were boosted.

The Commission estimated that the increase cost Edison approximately $68,000 annually. Metropolitan is to answer why the contract should not be declared invalid and penalties imposed.



A. R. SCHILLER, left, president, Public Service Co of New Hampshire, and T. S. Knight, commercial vice-president, General Electric Co, examine a model of a 7,500-kw mercury turbo-generator and condenser boiler at the recent New England Conference in Boston. Two such units and a steam turbo-generator will outfit a new 40,000-kw plant of the utility at Portsmouth

There Is a Santa Claus

Last week the Genoa (Wis.) light and water plant was desperately in need of coal. Coming up the Mississippi was a convoy of coal barges bound for Northern States Power Co plants. Near Genoa two barges sprang leaks. The rivermen managed to float the barges into Genoa. There 4,000 tons of coal were unloaded. By telephone the municipal made a deal for the coal with the utility.

2 More Projects Planned for Wisconsin River Sites

MADISON, WIS.—A major additional development of this state's hydro-electric resources is actively under way on the Wisconsin River. Application has been filed with the Federal Power Commission seeking licenses for hydro plants at Petenwell and Castle Rock, near Necedah.

Already, at least a score of dams and power plants are in operation on the stream, which is described as one of the hardest-working rivers in America. With completion of Petenwell and Castle Rock, the Wisconsin River will be one of the most completely harnessed streams in the land, its developers say.

Wisconsin Public Service Corp and Wisconsin Power & Light Co joined the Consolidated Water, Power & Paper Co in forming a new organization to develop Castle Rock and Petenwell. The latter firm contributed its land and dam sites to the new company—Wisconsin River Power Co—while the two utilities were to put in $1,500,000 each. Ultimate cost of the twin development has been estimated at $12,500,000. About $8,500,000 of the capital is expected to be in bonds, the remainder in stock. Output of the two plants—estimated at 95,000,000 kwhr of firm energy and 82,000,000 kwhr of secondary annually—is to be divided equally among the three incorporators. The Petenwell plant is to be of 28,800 hp, and the Castle Rock plant of 21,500 hp.

It was reported that the new company—Wisconsin River Power—plans to encourage extensive development of the area surrounding the Petenwell Lake for resort purposes.

•

Research Labs Listed

A complete listing of commercial and university testing and research laboratories throughout the country, together with indications of the type of commodities tested, has been compiled by the National Bureau of Standards. Information is given concerning 220 commercial laboratories, with 80 branches or offices, and 189 college laboratories used for research and testing as well as instruction.

Listings are arranged both geographically and alphabetically to facilitate ready location. The publication, M187, may be obtained from the Superintendent of Documents, Washington 25, D. C., at 30 cents a copy.

VEPCO and Co-op Battle to Serve Same Territory

Charges and countercharges are flying thick and fast in the Tidewater section of Virginia where a utility and a co-op are seeking to build a rural distribution system.

The battle of press statements was transferred this week (Dec 12) to Richmond where the State Corporation Commission was scheduled to hear the petition of the Chickahominy Electric Cooperative for authority to borrow $279,000 from the Rural Electrification Administration. Another petition to be heard at the same time was one of 12 James City County residents asking the SCC to force VEPCO to extend electric service to their rural homes.

The trouble started Dec 4, when Allan Arness, field representative of REA's Applications and Loans Division, charged the utility with refusing to serve the territory until after the co-op was formed. Then, he accused, the utility started "vicious spite-line" building to "skim the cream" off the territory and force REA to withhold its approval of any loan to the co-op.

He also accused VEPCO of being responsible for the formal hearing set by the SCC. He said that under normal procedure the application of the co-op to execute loan notes would have received routine approval.

J. G. Holtzclaw, president of the utility, countered with a statement that the utility has claimed the territory for years. Furthermore, the company had plans for the lines drawn before the co-op was organized. If cooperation can be secured from landowners in providing rights-of-way, the work will be completed by the end of 1948.

The co-op plans to operate in Hanover, James City, Charles City, and New Kent Counties.

•

Salem, Ore., Co-op Granted Limited Franchise by City

An ordinance granting a general franchise to Salem Electric, cooperative utility, was defeated recently by the Salem, Ore., City Council. At the same time, it voted to grant the utility a limited franchise which confines the co-op's scope to the area now being served plus some parts of North Salem annexed to the city after permits to the co-op had been granted by the County Court.

The limited franchise requires a payment of 3½ percent of gross receipts and contains a provision that the franchise may be terminated on 90 days notice. The general franchise requested was for a period of 5 years and required a 3-percent payment.

Harry B. Reed, manager of Salem Electric, announced that he would recommend to the board of directors that the limited franchise be rejected. Salem voters in two elections voted down proposals to grant the co-op a general franchise. Salem is now served by the Portland General Electric Co.

•

Industrial Power Reduced

Omaha Public Power District has asked its larger industrial power consumers to reduce power use from 10:30 am to noon and from 4:30 to 7 pm, Tuesdays and Wednesdays. These are the periods when power demand is heaviest.

CONSTRUCTION starts on one of the longest underground high-voltage cables in the world. The spectators are officials of Detroit Edison Co. The 120-kv line will be 13 miles long and will connect Warren Station with Northeast Station. A nitrogen-filled pipe will enclose cable with three conductors

'Price at Shipment' Policy Adopted by Westinghouse

As of midnight, Dec 12, Westinghouse Electric Corp is selling its heavy electrical apparatus under a "price at shipment" policy. The announcement that the firm was abandoning its firm-price policy, established last May, was made by J. H. Jewell, manager of apparatus sales.

In making the announcement, Jewell said that a "limit of 20 percent has been placed on the price increases possible between the time an order is taken and the time equipment is shipped."

He said that Westinghouse set the new policy with great reluctance. He pointed out that when firm prices were established, the company expected the prices of materials to drop. Instead they rose. Now the company has booked approximately $290,000,000 of business that will have to be produced at unpredictable higher costs over the next three years.

•

Portland Grants Franchise

Portland, Ore., City Council has approved a 20-year franchise for the Pacific Power & Light Co. But the voters will have to add their approval at an election on May 21, 1948. The only major change from the former franchise is a provision allowing the city to purchase the utility at any time instead of in the last six months of the franchise.

MEETINGS

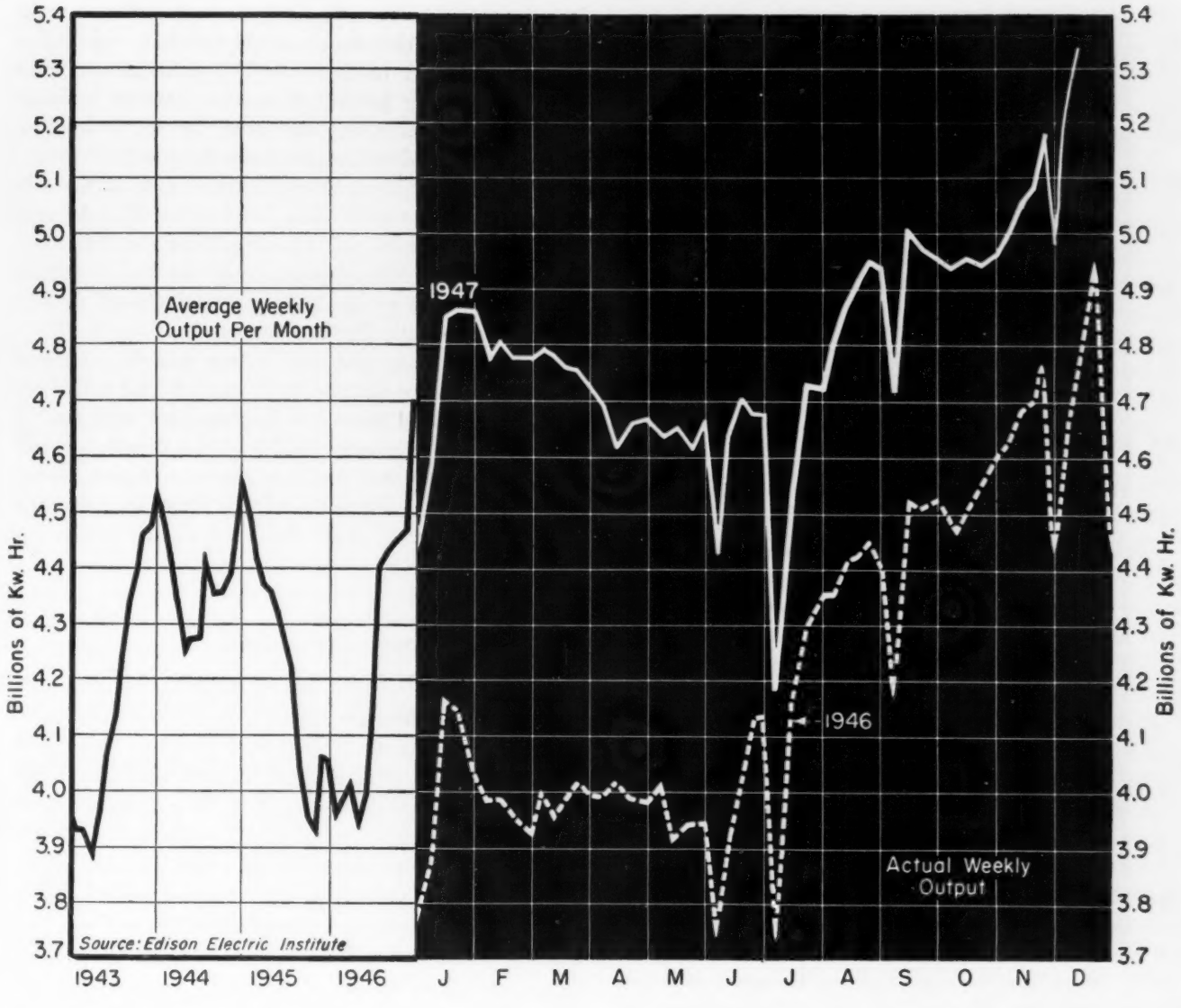
Previously Listed

Canadian Electrical Association—Winter Conference, Chateau Frontenac, Quebec, January 12-18.

American Institute of Electrical Engineers—Winter General Meeting, William Penn Hotel, Pittsburgh, January 26-30.

Missouri Valley Electric Association—Power Sales Conference, President Hotel, Kansas City, Mo., February 5-6.

Edison Electric Institute—Meter and Service Committee, Joint Meeting with the AEIC Committee on Metering and Service Methods, Biltmore Hotel, Oklahoma City, Okla., February 9-11.



10,000,000-Kva Breakers to Be Installed at Coulee

Contracts aggregating $1,516,788 for twelve power circuit breakers having the highest interrupting rating of any commercial breakers yet built—10,000,000 kva at 230 kv—recently were awarded to the General Electric Co and the Westinghouse Electric Corp by the Bureau of Reclamation. The breakers, together with associated isolating and grounding devices and 30 high-voltage lightning arresters, are to be installed at the Bureau's Grand Coulee power plant. Highest interrupting rating of any commercial breaker in service in this country to date is 3,500,000 kva.

The proposed Grand Coulee breakers are to have an interrupting-time rating of three cycles and a reclosing time of 20 cycles. They are specified for 230/196-kv service and will have a continuous current-carrying capacity of 1,000 amp. Three-phase interrupting capacity at rated voltage and frequency is to be 10,000,000 kva, as stated.

The General Electric Co has contracted to supply six of the twelve breakers, together with associated isolating and grounding devices and twelve of the 30 single-pole, station-type, outdoor lightning arresters that will be installed. The GE contract is for $748,603.20. Westinghouse will supply the remaining six of the twelve breakers and 18 of the 30 lightning arresters. Amount of the Westinghouse contract is $768,184.80. Both contracts call for delivery 900 days from October 3, according to information released to ELECTRICAL WORLD.

Other News

New Equipment ..... Page	98
News About People	108
Manufacturers & Markets	114
Construction	116
Recent Rate Changes	119

Electric Output Soars

Moving sharply upward, the electric output curve again reached a new high during the week ended Dec 13, 1947, E E I reports. The amount of electrical energy distributed totaled 5,327,470,000 kwhr, comparing with 5,217,950,000 kwhr during the preceding week. Output during the comparable week of 1946, Dec 14, totaled 4,777,943,000 kwhr, this year's figure representing an increase of 11.5 percent.

Weekly Output, Millions Kwhr

1947		1946		1945	
Dec. 13	5,327	Dec. 14	4,778	Dec. 15	4,154
Dec. 6	5,218	Dec. 7	4,673	Dec. 8	4,097
Nov. 29	4,933	Nov. 30	4,448	Dec. 1	4,043
Nov. 22	5,180	Nov. 23	4,765	Nov. 24	3,841
Nov. 15	5,084	Nov. 16	4,700	Nov. 17	3,985
Nov. 8	5,057	Nov. 9	4,682	Nov. 10	3,948

Percent Change from Previous Year

	Dec. 13	Dec. 6	Nov. 29
New England	+ 9.3	+ 8.9	+10.1
Mid-Atlantic	+10.6	+10.1	+10.8
Central Industrial	+13.7	+15.1	+14.1
West Central	+14.5	+13.3	+17.3
Southern States	+ 9.8	+10.6	+11.9
Rocky Mountain	+12.0	+11.3	+11.8
Pacific Coast	+10.5	+ 9.1	+ 8.4
Total United States	+11.5	+11.7	+12.0

Electrical World

OPINION

PL Should Roll in '48

THE PLANNED LIGHTING Program is marking time. There are some who are disturbed. They should not be.

The Program depends on the electric utilities for its push. They are not pushing it now. As a whole, the industry does not now give, has not since the beginning been able to give, to the Program the enthusiastic support it must have. The reason for this condition is well known. Ever since the Program was announced, the collective mind of utility management has been preoccupied with the problem of generating capacity.

For most utilities, that problem will reach its most acute stage a day or so before Christmas. On that holiday, many, we hope all, utility managements will be happy in the knowledge that the 1947 peak load was carried successfully. Even the few on whom Fortune may not have smiled will be relieved that the strain is over.

Then the Planned Lighting Program will have to be sold to utility managements almost as though it were just newly announced. They will have to be shown again what they had neither time nor inclination to look at before: that the Program will prevent misapplications of modern light sources which, if they do not cause actual reductions in lighting revenue, will certainly keep its increase far below what it could be; that the market for new lighting does now exist, that poor lighting will be sold to it if good lighting is not, and that the utility will suffer thereby; that an adequate lighting sales organization must be built up by recruiting, training, and tempering with experience many more men and women than the utilities ever before employed in this line of work; that it takes about two years to make a competent lighting salesman and that in this respect, special urgency lies in the old sun dial's admonition, "It is later than you think."

Obviously, the utility must be the local spearhead in putting the Program to work. And to sell the utility on it is essential. But there are others who must be sold on it too—contractors, distributors and, strangely enough, manufacturers of lighting fixtures and equipment, particularly the smaller ones and the newcomers in the field. These others have a different kind of stake in the Program from that of the utilities. Different kinds of arguments must be used to enlist them in it. The contractor loses money when he sells a job down in order to make his bid low. The distributor should maintain and display an adequate stock of fixtures. The manufacturer must turn out a quality product if he is to stay in business. These are samples of the arguments by which the Program must be sold to the others necessary to it.

This selling largely waits upon the motion of the utilities because most of it must be done locally. As contractors, distributors and fixture makers see that users are accepting the idea of planned lighting and are ready to pay for quality equipment competently installed, they will wax enthusiastic for the Program

Indications from spot checks and sampling surveys among utilities are that the fresh start of PL-PL in 1948 will be on a broad front and in impressive numbers. If these indications correctly foretell what is ahead, we shall see in the coming year such a piling up of lighting business as to keep the Planned Lighting Program rolling for a long, long time.

Prizes and Prize Winners

AS THEIR NAMES were called, the 4-H Club girls and boys lined up before the speakers' table after the dinner. They were the guests of the power company which had sponsored a contest in projects of farm and farm-home electrification in its service territory. The county winners were handed impressive-looking "Certificates of Merit" by the company president. Then came the high point, announcement of the winners of the grand prizes.

The second prizes were presented to the girl and boy winners, small ribbon-tied packages. "Open them, open them," the others demanded. And such applause followed when the two lucky ones held up the beautiful wrist watches they had won. They walked proudly back to their seats, their faces wreathed in smiles.

And now the winners of the first prizes were called: They'd receive something even more wonderful. More than a few envious glances marked their way to the front of the room. Anticipation shone in their eyes and eagerness was in their steps. But the anticipation faded and the eagerness was gone when the president produced, not another pair of exciting-looking packages, but two more rolled-up certificates. "You have won," he declaimed, "scholarships of $100 each in any college in the state. When you are ready to enter, let me know and a check for $100 will be sent to the college you choose."

Glumly the girl and the boy took the certificates and trudged back to their seats. Perfunctory was the word for the applause that died out before they sat down.

Given the choice, what boy or girl of fourteen or fifteen would take, in preference to a swell wrist watch now, a $100 scholarship four or five years in the future? We suggest that this question is worth consideration by any power company engaged in or planning such activity as is indicated here.

Frequency and Economy

PLENTY OF STRESS has been put on maintenance of constant frequency. But has enough importance been attached to the consequences of momentary changes in frequency? These "iron out" in the long run—have no residual result in time, but meanwhile, they may have been harmful.

There has been growing a feeling that continuous seesawing and quivering of frequency is costly or wasteful. The feeling grows, also, that the phenomenon arises mostly from unsynchronized efforts by operators, governors and tie-line load controllers to avert or correct for the changes.

Why does the issue deserve critical analysis and why should technical solutions be welcomed as timely? Simply because incessant adjustment against incessant frequency drift wears out the automatic adjusters, controllers and instruments. It keeps boilers, turbines, and fans, in fact system equipment in general, from turning out optimum output and performance. Anything whatever subjected to a seesawing loading will be kept from doing its most and best.

Prominent in this arena at the moment are the engineers of Pennsylvania Water & Power Co. They have encouraged J. E. Allen to perfect his extremely sensitive frequency meter. By means of it, they are learning points about frequency that are not generally recognized. As Carroll Merriam put it, "Allen found that the frequency at his home changed momentarily every time the refrigerator started."

That is not so far fetched because frequency manifests itself as the cyclic variations in voltage. Voltage has to shift in phase to supply the torque current. Frequency, therefore, lags momentarily and elastically, and then resumes its 60-cycle tenor. Every little load has an effect, locally, that is comparable to the well recognized fact that large blocks of load will slow down the turbo-alternator until the governor can act to recover. Rate of change of frequency is the index.

The objective in the program should be to refine the speed and frequency and tie-line-load controls as a group so that the frequency perturbations can be as well localized as are the load changes that cause them. Localization will prevent their spread over interconnections and let equipments in other areas continue their unruffled tenor. Refinement in frequency metering and control is far from academic in import. It can lead to reduction of economic loss and waste on power systems.

Blue Sky

A NEVADA RANCHMAN has filed legal claim to all water in all clouds passing over his ranch. We think his claim should be favorably treated whenever it arrives before SEC. After all, there's nothing "blue sky" in this proposition.

WASHINGTON COMMENT

W. B. WHICHARD

ONE BEGINS to wonder if the Marshall Plan for European relief is about to evolve as the bureaucrats' plan for aggrandizement of our federal agencies. Not that Secretary Marshall—or much less the President—planned it that way. But some lesser satellites in the Administration have seized upon the present national concern over foreign relief as a mandate to expand their own purely domestic operations.

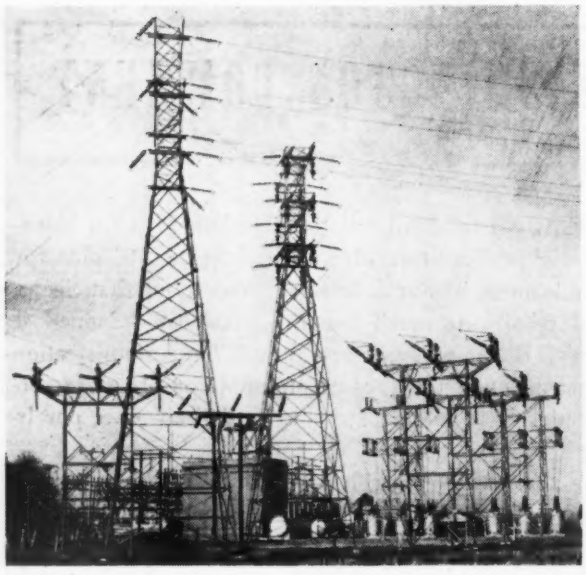
Take the Rural Electrification Administration—which no one yet has "taken" in the political sense, incidentally. Hardly had Secretary Marshall finished speaking at Harvard last June before alert REA spokesmen began pointing out that increased aid for Europe would require more food production on U. S. farms. In REA's book, more farm production means more farm electrification, and more farm electrification means bigger and better loans by REA. And, if you say it fast enough, it's obvious that only case-hardened isolationists out to sabotage the Marshall Plan will vote against increased REA appropriations next year.

Or, maybe you prefer a Reclamation chaser with your European relief binge. After all, REA still thinks of spending only hundreds of millions annually. Reclamation Commissioner Michael Straus, who has been at it longer, would spend billions in connection with the Marshall Plan. Billions for Reclamation, that is.

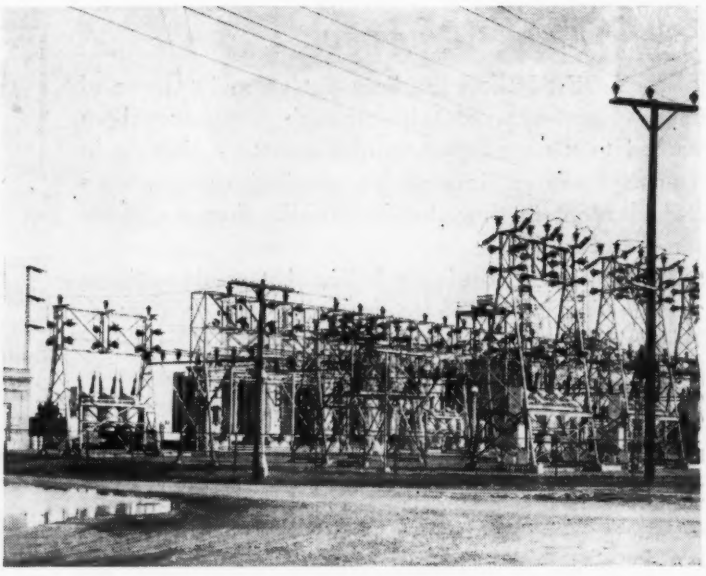
Though his inclination to spend is less inhibited, Straus employs somewhat less involved reasoning in his justification therefor. If the U. S. must increase its food output, it can do so by adding thousands of acres to its productive farm lands, he holds. It is against the ground rules, at this point, to ask Straus to produce more farmers to till his new lands. Anyhow, that's a problem for another department—Labor, no doubt.

To get more farm land, Straus would "expedite" irrigation construction by the Reclamation Bureau. Last week he told a Congressional committee the Bureau could put 5,607,000 acres of now-arid lands under irrigation in the next four and one-half years—the prospective life of the Marshall Plan. Total cost of this accelerated program would be $1,366,700,000, Straus estimated. It included projects in all stages of development, some already under construction and 20 not even authorized. Naturally, the Bureau also plans to carry on the rest of its projects at normal speed, subject to regular—and sizable—annual appropriations.

You'll be disappointed in the Tennessee Valley Authority. Apparently it is willing to let the President, Congress and the State Department carry out the Marshall Plan by themselves. Or is that new steam generating plant planned by TVA really going to turn out dehydrated kilowatt-hours for shipment abroad?



HIGH SIDE of East Nicolaus substation. This station has connections to four 110-kv incoming lines and five 66-kv outgoing



LOW SIDE of same station. Switching sequences for incoming lines and sub-transmission feeders are under full automatic control

Automatic Control Supplanting

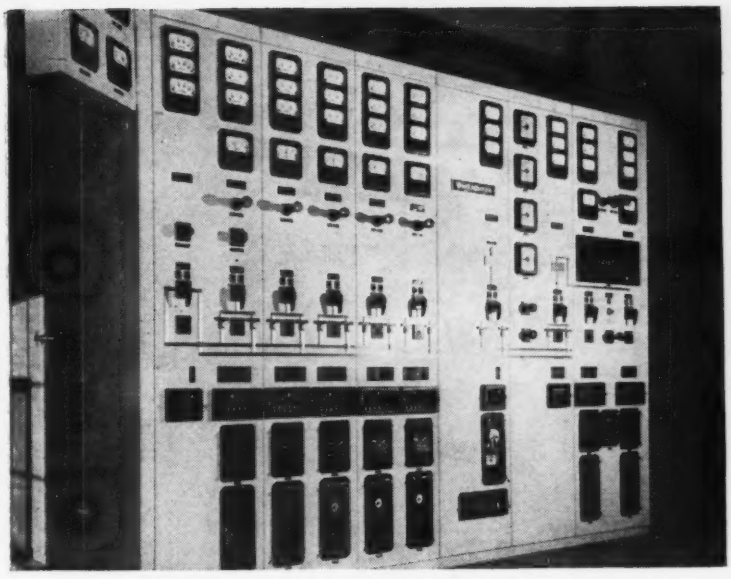
F. I. LAWSON
Ass't Engineer
Division Electric Distribution Engineering
Pacific Gas and Electric Co
San Francisco, Calif.

HIGHER LOAD DENSITIES and the greater premium being placed on continuity of service call for faster response and greater accuracy in performing sequences of switching operations. These have led Pacific Gas and Electric Co into further extensions in the field of automatic substation control. Its pattern of automatic high-voltage switching, a natural product of its system development, has now reached impressive proportions. This program already embraces full automatic control for such important transmission substations and switching centers as its East Nicolaus station. This station has connections to four 110-kv lines and five outgoing 66-kv lines, with 50,000 kva in transformer capacity between the 110 and 66 kv and another 3,750-kva bank to supply four local 11-kv feeders. This station is described later in more detail. Making such a major substation fully automatic and unattended shows the company's confidence in presently developed automatic network controls.

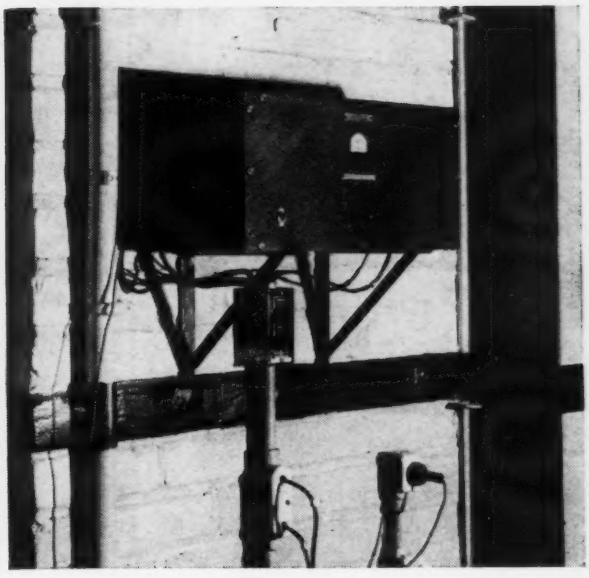
The program had an inconspicuous beginning in 1929. It originated at a 1,000-kva suburban substation where the station was automatically thrown over from one 66-kv line to another following failure of service from its normal source. Automatic switching is now applied as a matter of general practice to all 66-kv circuits. It is also applied to many of the 110-kv circuits. For a number of new 220-kv switching installations, fast automatic reclosing is programmed. Provision is being made for subsequent addition of single-phase relaying and reclosing. This is coupled with a general practice of automatic control for all synchronous condensers and for medium or small hydro plants. This results in a highly complete state of automatic operation for a major proportion of the company's transmission and high-voltage distribution network.

To gain perspective, it is worth noting that in the course of interconnecting the generating sources with the distribution lines, there are some 325 so-called primary substations. These are located along or at interconnecting points of the 8,000 miles of 220-, 110- and 66-kv transmission and sub-transmission circuits operated by this company. The term "primary substation" is used to designate those which are used to feed power into so-called distribution networks or directly to customers. Twenty-nine are attended switching centers which play a part in sub-dispatching operations; 206 are of the simple tap-line station type with primary leads to the step-down transformers, either fused or protected with breakers. Most of the latter are equipped with reclosing feeder breakers, but for the purposes of this discussion these stations are not considered as automatic substations. The latter term is used herein for those stations where some degree of switching selectivity must be utilized in restoring service following line outages.

Of the remaining 90 stations, 31 are fully automatic; two have supervisory control from an adjacent station; and 43 others are definitely programmed for conversion to automatic control; 5 probably will become switching centers. This leaves only 9 stations for which there are no plans as yet for conversion, due to their usefulness for other than



AUTOMATIC CONTROL SWITCHBOARD showing selective "feature" switches, reclosing control devices and annunciator



ALARM SIGNAL TRANSMITTER for sending an alarm by telephone line carrier to the division switching center

Supervisory for 2,000,000-Kva System

Seventeen years' experience with automatic operation of medium high-voltage networks leads to choice of automatic rather than supervisory control for system expansion and modernization program

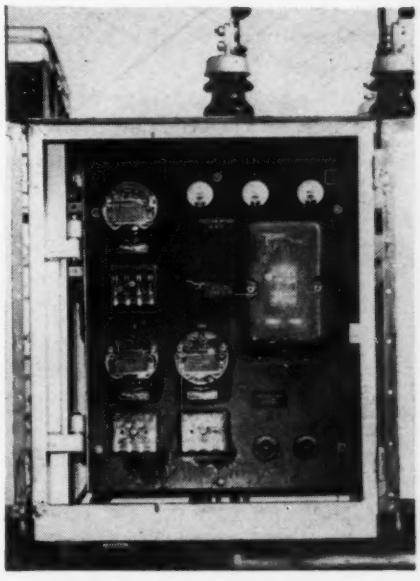
straight switching purposes and uses.

Approach to present-day operating problems requires a thorough analysis of the problem, both economic and operating, and the development of a guiding philosophy in differentiating between supervisory and automatic control. Pacific Gas and Electric uses both. Choice depends not only on the problem but also on *how the problem is viewed.* There seems to be a tendency on the part of engineers to seek too complicated a solution in this matter of choice of substation control.

Automatic vs Supervisory

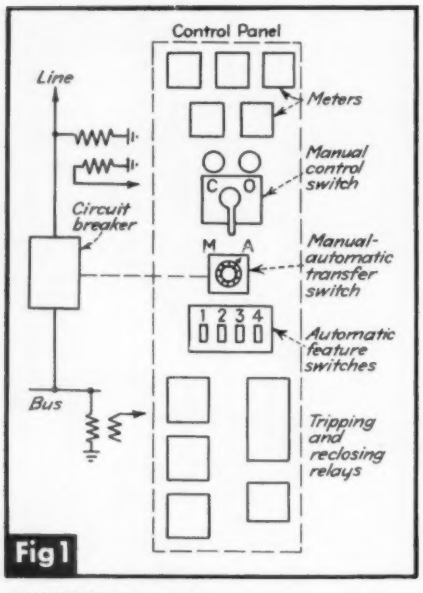
The extensive use of automatic switching by Pacific Gas and Electric Co at medium high-voltage substations contrasts the frequent resort under similar circumstances on other systems to "supervisory" control, manually performed from a remote point. This is not meant to imply that supervisory control does not find a field of application under appropriate conditions, such as cases where switching operations are not predeterminable, or cases where an attended station is within easy control distance from an operating center. These conditions are more often met in the urban districts, at lower voltages.

Reasons for the preponderant use of automatic substations on the high-voltage networks grow partly out of the distributed nature of the company's territory and load, but mainly from proven gains in economy and reliability of service. Also automatic devices for tripping and reclosing switches are more reliable and faster than human reactions. Their use for the performance of routine predeterminable operations at outlying stations can easily be shown to be more economical than manual attendance.

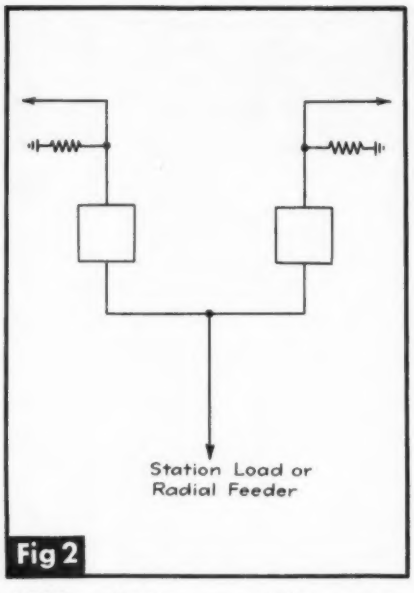


AUTOMATIC reclosing control panel of conventional outdoor type for 11-kv feeders on network systems

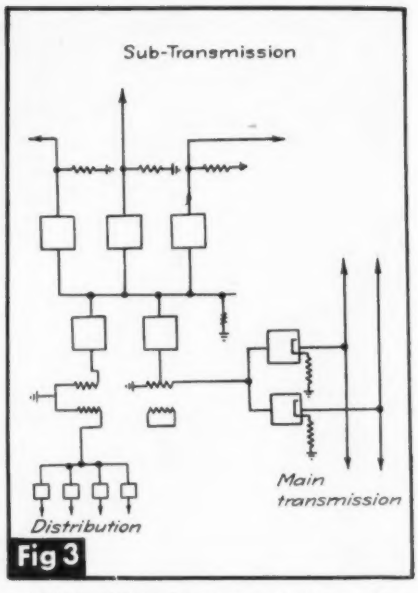
A noteworthy point in connection with the present application of automatic switching is the method of providing operating flexibility in the control. The acceptance and the success of this automatic substation program is in great measure due to the



FUNCTIONAL unit arrangement of oil circuit breaker control



LOOP substation or switching point with two sources of power



MULTI-SOURCE station similar to East Nicolaus location

operating flexibility incorporated in the control circuits. A primary purpose of this article is to describe the means of providing this flexibility and the resulting simplification in operation of the system.

A simple analysis of the switching operations required at a substation indicates that switches are closed under one or more of the following conditions:

(a) When voltage is present on the line side but not on the bus side of the breaker. Closing the breaker reenergizes or *restores power* to the bus or substation. (b) When voltage is present on both sides of the breaker or switch. Closing the breaker or switch *reparallels* the system at this point. Before this is done a check for synchronism, of course, must be made unless system connections positively eliminate need for such a check. (c) When voltage is present on the bus side but not on the line side of the breaker. Closing the breaker reenergizes or *tests* the line.

Another operation which often is required at a substation is the sectionalizing of lines following trouble conditions elsewhere on the system. This means the tripping of one or more circuit breakers or switches under conditions not covered by line protection relays; for instance, tripping on complete loss of power from the sources supplying the substation. Most system switching to restore normal operating conditions following disturbances requires no more than the performance of one or more of the above operations.

The arrangement of control for a single circuit breaker is shown in Fig 1. Here it will be noted that, in addition to the usual control switch, there has been added a manual-automatic transfer switch and immediately below a group of four "feature" control switches. These "feature" switches, when closed, control the functions just described:

Feature Switch 1—trips the breaker on power failure; a preliminary step in the orderly restoring of system conditions following complete station outage.

Feature Switch 2—recloses to restore power to the bus if voltage appears on the line.

Feature Switch 3—Recloses to reparallel if voltage is present on both the bus and the line.

Feature Switch 4—Recloses to reenergize or "test" the line if voltage is present on the bus but not on the line.

The use of these feature switches to permit changing the operating orders applying to the station will be evident when the circuit breaker is considered as a unit in the station controlling the flow of incoming or outgoing power, power to a transformer or to a radial feeder. This flexibility of operation is obtained by interposing in the reclosing relay circuits appropriate voltage checking or interlock relays, and the reclosing "feature" controls are derived simply by connecting cutout switches in these potential circuits. Tripping on power failure is accomplished through an undervoltage relay with appreciable time delay characteristics to prevent tripping on momentary dips.

Other interlocks provide for lockout or single-shot testing of the station bus following tripping from bus or transformer fault relays. Since the control is determined by voltage conditions, potential transformers or potential devices are required for each side of the breaker.

Slip Contacts

For installations at new stations, it is becoming standard practice to use "slip contacts" on breaker control switches to perform the function of the automatic-manual transfer switches. However, many operating people favor the clarity afforded by the separate transfer switch. For most network installations a moderate delay in reclosing is desirable for sequencing with other stations. Usually the same timing can be applied to reclosures under any of the three conditions. Where longer timing is required for one or another of these conditions, it can be obtained either by inserting an additional timing relay in the feature control current or by modifying the reclosing relay current. For multi-circuit bus-to-bus applications where heavy loadings justify carrier or pilot wire checking at the opposite ends of the lines, fast reclosing is being applied.

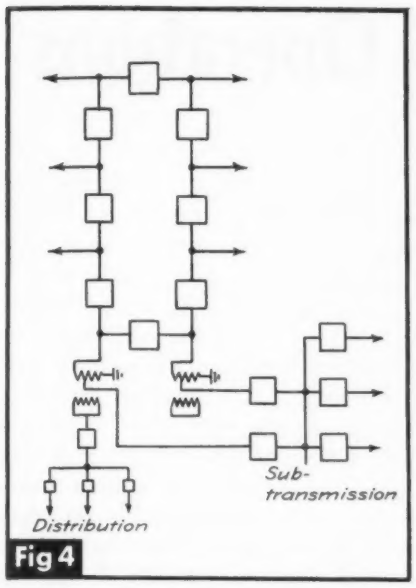


Fig 4

RING bus station arrangement. Protective relays trip adjacent breakers

In Fig 2, a simple two-source substation or junction point is shown. Here, power is maintained on a bus from either or both of two sources, and no provision need be made for backfeed from the station. The sources of supply may be:

(a) Part of a loop network, in which event the station often is referred to as a "loopstation"; (b) taps to a pair of transmission lines.

Normal operating condition for the loop station is to have both breakers closed to maintain a through connection to adjacent stations. By proper choice in closing the feature switches, the restoration of service following outage of one or both lines can be made to take place in sequence from the source on one side to the other or vice versa, or the closing through of the loop may be withheld. Frequently the normal operating condition for the second case is that both circuit breakers are kept closed and tap line selective relaying is applied to the source lines.

Sequence Changing

Under either of the above conditions, the station may be operated from only one source with provision that on loss of power the station load will be transferred to the other line or tap. Hence, with a separate group of standard feature switches available for each breaker, the system operator can change the sequencing of operation of several stations.

Changes in sequencing in effect are changes in the operating orders applicable to the station. With self-contained automatic control, these changes can be made only at the station. But if required at frequent intervals, the possibility of applying a remote supervisory control system to the positioning of the feature switches is apparent. Such a cascading of control would enable self-contained automatic operation plus remote revision at will of the switching sequences under which the station operates in the network. As yet, no installation of this cascaded control has been attempted by PG&E.

Application at Larger Network Centers

Connections at a larger station similar to East Nicolaus are shown in Fig 3. This illustrates the further application of the foregoing principles. For such stations, with so many possible sources of supply, it has not been considered necessary to provide for tripping all lines on total power failure. This is because of the very remote likelihood of its occurrence. In other respects there is no difference between the application of automatic control to the breaker units of this station and to those of a two-source station. The setup of controls for the station is simply the result of establishing for each individual source-line an order of precedence between the local station end of the line and the opposite end as to line testing or reparalleling.

Line Facilities

Additional line facilities at East Nicolaus, beyond those diagrammed in Fig 3, and discernable in the two photographs of the station exterior, include: A double 66-kv bus arrangement; two additional 66-kv lines; and transfer switch connections to two additional 110-kv lines. The control and metering side of the double-front switchboard shows the actual arrangement of controls, including the annunciator board at the right. This board assists in quick identification at the station of any abnormalities. A simple remote alarm signal system also is used at this and a number of other automatic stations to transmit indication to the division switching center of these abnormalities. The annunciator drops are arranged to transmit only two signals: An "urgent" one for conditions which require immediate attention, such as breaker lockouts, control bus failure, transformer or bus differential operations; and an "ordinary" signal for other conditions, such as low output from battery charger, which can await more convenient attention. The alarm signal transmitter, which is a small telephone carrier set operating over company telephone lines, is shown in one of the accompanying photographs.

Conventional Accessories

The normal line and bank protective equipment, plus station control battery and charging set, completes the installation in the control building. Standard a-c reclosing relays, together with tripping relays for the 11-kv feeders, are housed in individual cabinets attached to the outdoor 11-kv feeder breaker framework, as illustrated.

Fig. 4 shows a projected ring bus arrangement of eight breakers for six transmission lines and two transformers. This represents an interesting variation in applying the foregoing principles of automatic control. In this case, the protective relays for lines and transformers trip the two adjacent breakers in the ring. Normally the reclosing control for each breaker is set to close in the same sequence around the ring. For instance, reclose to restore power to the section on its right, and if power is on the righthand section but not on the left, withhold reclosure until reparalleling conditions are fulfilled.

Designation of the feature switches is modified to the following:

Feature Switch 1—Trip on power failure (as before).

2—Restore power line 1 to line 2.

3—Reparallel.

4—Restore power line 2 to line 1.

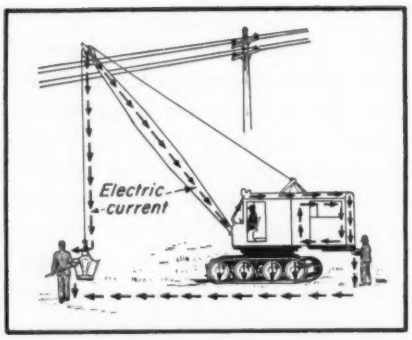
Following outages that require a line or transformer be kept out of service, isolating switches on the line or transformer taps are opened and the ring again closed. The flexibility available in this arrangement of the control for a station involving so many possible system conditions is self-evident. The possibility of applying variations of the above principles to extensive sections of a network is likewise apparent.

Safety-First in Boom Crane Operations

TOP PERFORMANCE in crane operation requires continuous, high-speed output. Safety is a requirement of efficient operation. To obtain continuous, accident-free operation, a knowledge of crane accident locations is important. In the interest of safety, the Loss Prevention Department of the Liberty Mutual Insurance Co has made an analysis of more than a thousand crane accidents that have caused lost-time injuries. The location and percentage of occurence of these accidents are:

	Percent
Working or standing under suspended load..	—17
Loss of load due to poor rigging, hooks or slings	—17
Fueling, checking water, oiling, or adjusting moving crane parts while equipment is in motion	—11
Operating without authority or signals.....	—9
Failure of defective boom, cable, or sheaves	—7
Working or standing in line of crane body or boom	—6
Pushing load by hand, including electric shock	—5
Unhooking, coupling, pitching, etc; with hands in pinch point	—2
Failure due to overloading.....	—2
Ascending and descending cab without using ladder	—2
Operating too near stationary equipment.....	—1

Crane operations close to power lines require utmost care. The electrocution hazard caused by the crane boom or fall cables touching power lines is one of the most serious in the construction industry. Since a closed electric circuit and a difference in voltage result in the passage of current, a worker can become part of such a circuit by contact with a ground and a live wire or electrically charged part. This is shown in the accompanying sketch. If the fall line cable or boom accidentally touches the power line, the crane, boom, cable, and attached bucket become electrically charged. Thus the crane operator has a heavy responsibility to prevent the boom or fall line cable from touching power lines. This responsibility becomes all the more important when it is realized that the crane operator is in a relatively safe position while in the cab. This is due to the low dfference in voltage across his body. A worker on the ground touching any part of the crane when it is charged becomes part of a closed electric circuit with a high voltage drop and would probably be electrocuted. If the operator should step off the crane when it is charged and have one foot on the ground and the other on the crane, he too would be electrocuted.



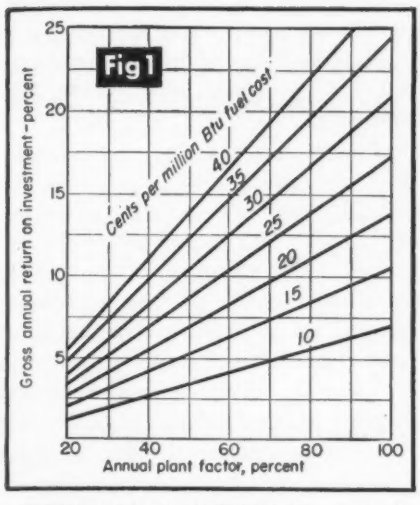
ELECTROCUTION is possible if crane boom or fall cables touch power lines. A worker on the ground touching any part of the crane when it is charged becomes part of a closed circuit with a high voltage-drop and is electrocuted

An additional analysis of ten accidents pertaining to the operation of cranes, derricks, and rigs has been made by J. O. Leslie, Director of Safety, Gilbert Associates, Inc. This analysis is shown in the accompanying table. Repetition of such accidents can be avoided if the following precautions are observed:

1. Erect mechanical barriers over the crane boom, cables and wires.
2. Have the lines de-energized.
3. Re-locate the power lines.
4. Maintain safe clearances.

Analysis of Accidents Caused by Unsafe Handling of Mobile Construction Equipment

Equipment	Operations	Employees	Accident	Contact	Electrocuted	Injured
Crane with 55-ft boom	Loading truck	Two	Standing on ground, pushing load on truck, when boom contacted line	13,000-volt line	1	..
Crane Tractor mounted	Being moved to new location; derrick elevated	Crane operator Tractor operator	Derrick being lowered, caught on live wire	6,900-volt line	1 ..	.. 1
Crane with 55-ft boom	Moving crates	Foreman	Grabbed swinging cable; boom contacted live wires	Overhead line	1	..
Crane with steel boom	Idle	Crew	Unloading crane from truck when boom contacted line	Overhead line	4	6
Pipe a 22-ft section	Well drilling; pipe being pulled out to clean auger	Two	Guiding pipe when upper end contacted energized line	Overhead	1	1
Well-digging rig with boom		Workman	Operating crank to raise metal boom when boom contacted line	4,600-volt line	1	..
Truck with derrick		Workman	Removing tools from truck which was energized when derrick hit primary line	Overhead line	1	..
Truck with derrick		Workman	Grasped winch cable after derrick contacted live wire	4,000-volt line	1	..
Well-driller boom	Preparing to drill a well	Two	While erecting boom, it contacted line	4,600-volt line	2	..
Shovel with boom	Proceeding in forward direction	Signalman	Attempted to get off machine after boom cable contacted line conductor	22,000-volt line	1	..



RETURN ON INVESTMENT required by a 1250-psi 950-F plant over that for 850-psi 900-F plant of base design

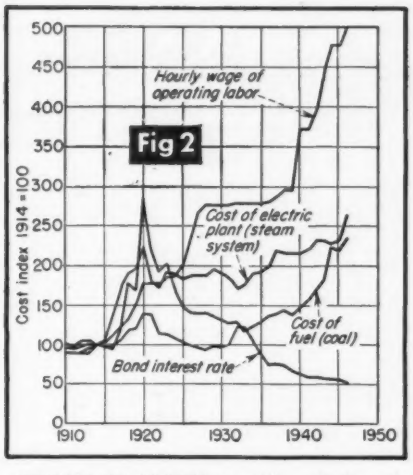
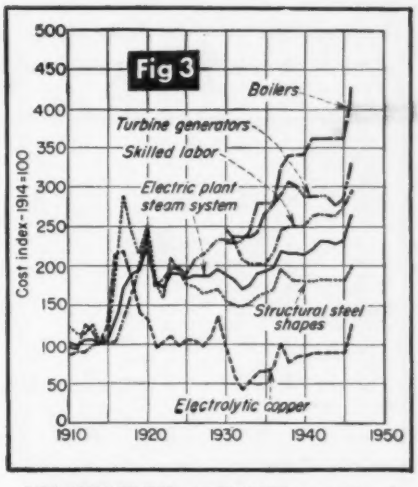


Fig 2
Cost index 1914 = 100
Hourly wage of operating labor
Cost of electric plant (steam system)
Cost of fuel (coal)
Bond interest rate

TREND OF COSTS for labor, fuel, and plant installation since 1914 base. Base cost index is taken as 100



COMPONENTS UPWARD trend inevitably is raising unit investment costs in the years since 1910

Reliable Simple Steam Plants Cost Less

J. A. POWELL
Chief Mechanical Engineer
M. J. LOWENBERG
Senior Electrical Engineer
Stone & Webster Engineering Corp

WITH PRESENT HIGH FUEL, labor and construction costs, most careful consideration should be given to over-all fixed charges and operating costs for new steam plants. Specifications should be based on hard cold facts.

Present increase in fuel costs probably justifies adoption of 1,250-psi 950-F operating conditions for systems previously using 850-psi 900-F units. Reliable plants can be constructed for pressures above 1,450 psi and temperatures of 1,050 F with or without reheat. These will be built where load factor and fuel cost justify these operating conditions.

Three fundamental principles enter plant design: (1) Plant must have high availability factor and be thoroughly reliable; (2) increase in capital cost for higher steam pressure and temperature over base design must be justified by lower fuel costs for the design load factor, and (3) plant layout should provide for a minimum of personnel.

* Condensed from a report before the Southeastern Electric Exchange.

Of 164 turbine generators larger than 10,000 kw purchased over about one year's time from May, 1946, to May, 1947, the bulk of steam capacity is designed to operate in the 650- to 850-psi range. Of the total of 7,206,750 kw, 4,058,750 are being installed for operation at this pressure. Another 1,502,000 kw operate below 1,250 psi. Further detailed classification shows 49 percent of the total are designed for 850-psi 900-F steam conditions.

The 851- to 1,250-psi units represent 21 percent of the total; units for pressures above 1,250 psi account for 16 percent of the total. Also, 350,000 kw will operate at steam temperature in the 1,050-F range and one 65,000-kw machine for 1,000-F initial temperature will have reheat to 1,000 F.

Of the 164 units studied, 60 ASME-AIEE "preferred standard" units represent 36.5 percent of the turbine-generators. Of these 49 of a total of 83 units in the 850-psi 900-F class represent 59 percent preferred standard machines.

It, therefore, may be concluded that 850 psi and 900 F represent the present-day design for the majority of new plants and that pressures above 1,450 psi and temperatures of from 1,000 to 1,050 F are practical considerations.

Taking 850 psi and 900 F as a base design, Fig 1 shows the approximate percent gross return on incremental additional capital investment for 1,250-psi 950-F plants.

In the past, rates for electricity have been steadily moving downward. With present-day cost of fuel, equipment, materials and labor, it is doubtful whether utility companies can maintain existing rates, even though engineers utilize every known improvement in the art of power station design in new construction.

Fig 2 shows trend of labor, fuel and electric plant costs using 1914 as 100 percent. Fig 3 shows trend of some component items entering into power plant costs.

Each plant must be designed for particular local conditions. The capital costs of items such as foundations, protection from floods, condensing water supply, railroad facilities, and fuel handling and storage, are not affected by steam pressure and temperature design conditions. Thus, the cost of individual power plants can not be compared on a kilowatt basis without making due allowance for differences in local conditions.

Items whose cost affects efficient operation are turbine-generator, steam generator, condenser circulat-

ing-water piping system, accessory equipment and high-pressure piping. The installed cost of these items is approximately $60 to $70 per kilowatt for 850-psi 900-F plant. Studies of capital cost and efficiency of these items form the basis of economic analyses for operating pressures and temperatures that are to be selected.

The use of standard operating conditions and size of turbine-generator units is an aid in keeping down capital cost.

In selecting the size of condenser, the tube length should be made as long as possible without incurring additional building floor space not required for the plant as a whole. The economical size of the condenser should be determined by weighing capital cost against fuel saving.

Vertical circulating water pumps located at the intake outside the turbine room, and use of pipes from the pumps to the condenser in lieu of gravity concrete tunnels, are least expensive. Chlorination of circulating water in most cases can be economically justified.

Preferred Standards

In the majority of cases where ASME-AIEE preferred standard units are used, four stages of extraction for feedwater heating are economical. Makeup is generally provided by an evaporator receiving steam extracted from the turbine. All normal auxiliaries are motor driven. However, an emergency boiler-feed pump, taking its suction from the distilled water tank, is provided in many stations.

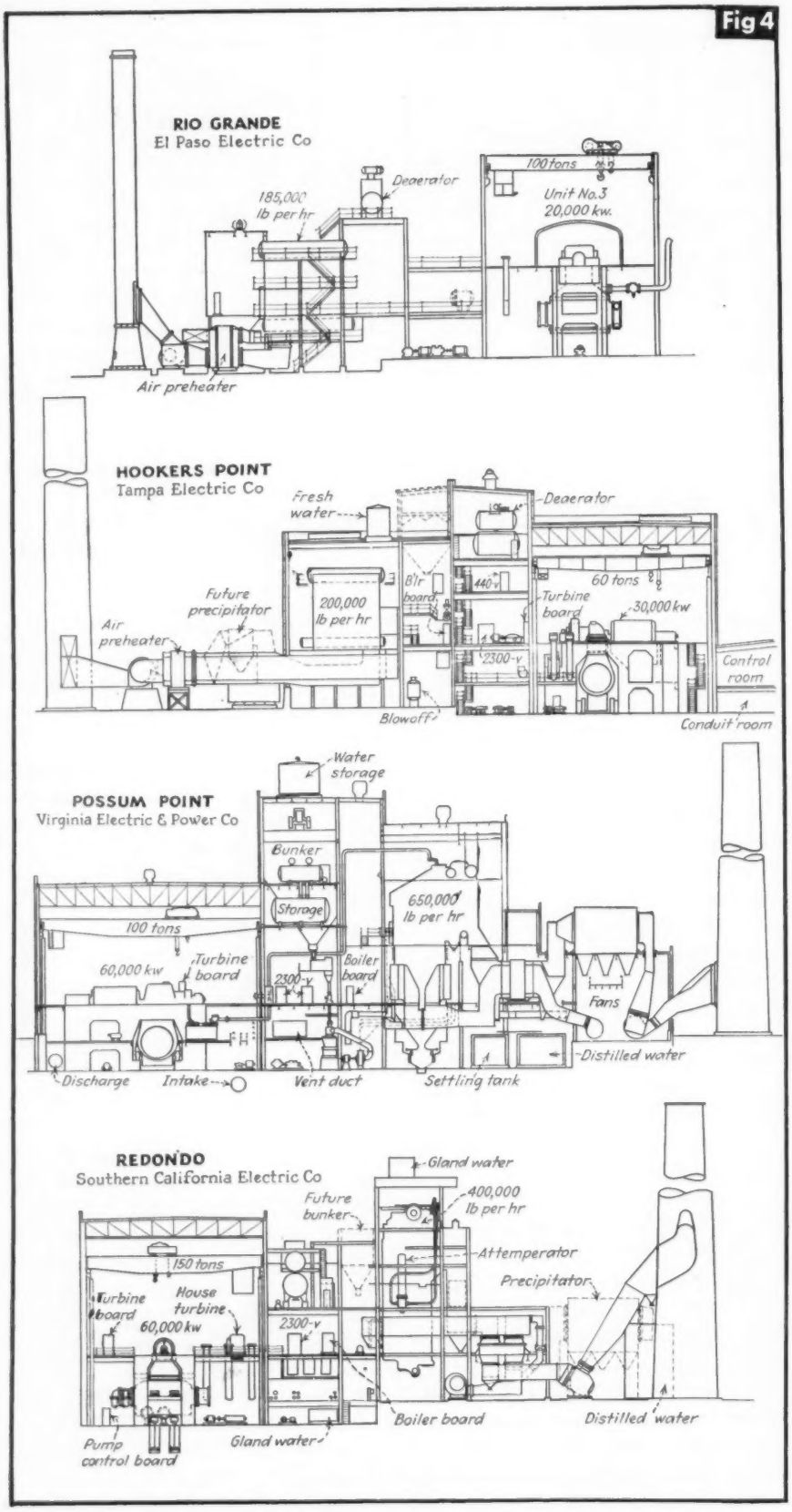
To keep initial costs as low as possible, new generating units should be planned on a unit basis, that is, one steam generator per turbine without piping inter-connections except through distilled-water storage tanks.

Structural costs for totally enclosing all equipment amount to between 12 and 20 percent of total construction cost. Superstructures alone represent 60 to 70 percent of the structural costs, or between 7 and 14 percent of the cost of new equipment.

Careful detailed studies of machine arrangements will assist in minimizing unused space and often aid operating efficiency. With the present relatively high cost of labor and materials for masonry construction, the use of asbestos or protected metal siding can effect appreciable savings.

Where climatic conditions permit, consideration should be given to outdoor construction. The only reason for placing equipment outdoors is to reduce investment cost. If the

Fig 4



PREFERRED STANDARD turbine-generators for 850-psi 900-F steam conditions as installed in four plants now being designed or under construction

superstructure could be reduced 50 percent by outdoor construction, this would represent a reduction of from 3½ to 7 percent of total plant cost.

To minimize number of operators, control of the plant should be centralized and, where possible, all operation confined to one floor level.

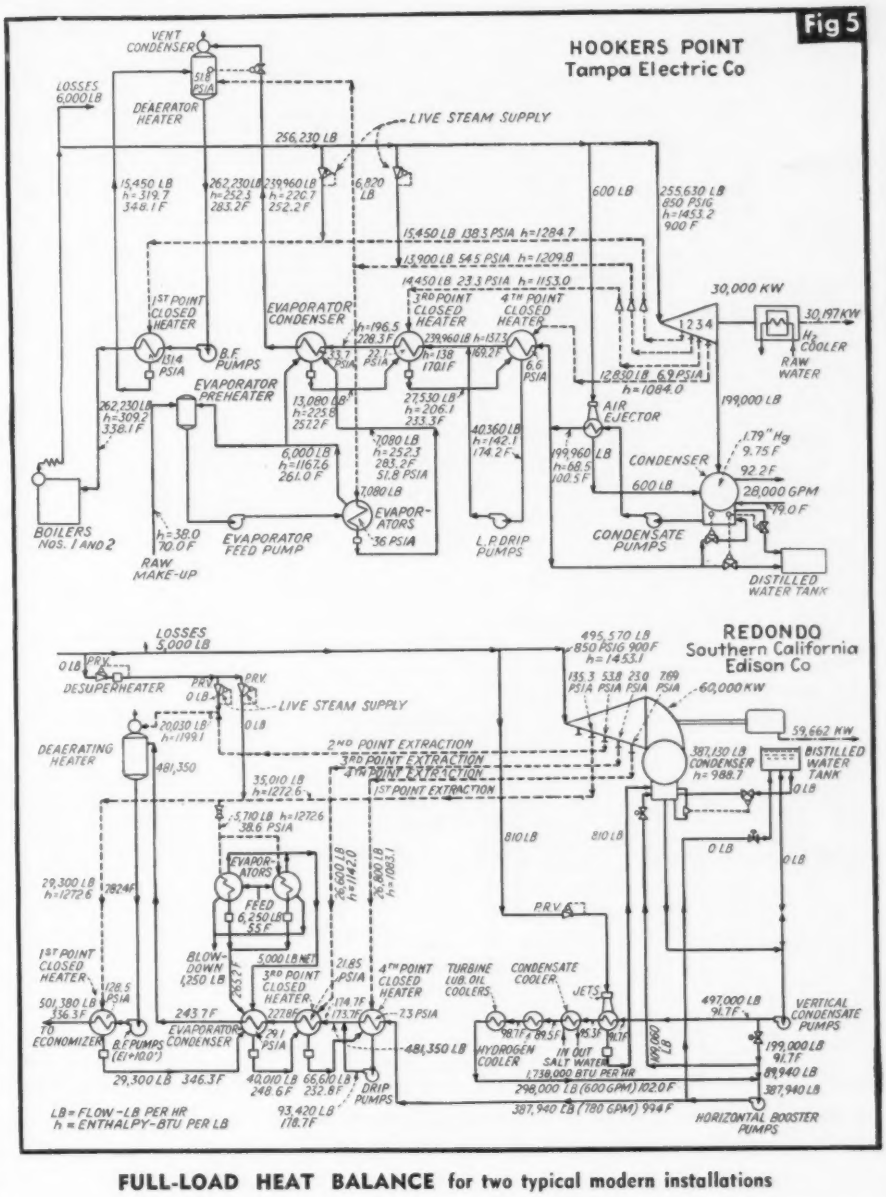
Fig 4 shows representative layouts of four stations, using 850-psi 900-F preferred - standard turbine - generators, now being designed or constructed by Stone & Webster Engineering Corp.

The cross-section of a 20,000-kw extension for the El Paso Electric Co is an example of outdoor design. The turbine-generator is installed outdoors, protected by a removable metal housing. The existing turbine crane serves the new unit. Boiler and auxiliaries are outdoors except for the boiler firing aisle, enclosed by corrugated asbestos.

The 30,000-kw unit for Hookers Point Plant of the Tampa Electric Co is housed in a corrugated asbestos building because of the great amount of rain at this location. At present, oil will be used as fuel; however, provisions are made for a future coal bunker, ash hopper and ash precipitator.

The 60,000-kw Possum Point Plant of the Virginia Electric and Power Co is a preferred-standard unit with four extraction points. The structure consists of a steel frame, corrugated asbestos walls instead of brick walls, and precast concrete roof. Similar construction is used for the intake screen well house, water treatment plant, and track hopper shed. However, the main service building has brick walls. Condenser circulating-water pumps will be located at the screen house on the shore line. Both intake and discharge lines consist of 6-ft diam buried steel pipe.

The Redondo Steam Station of the Southern California Edison Co includes two 60,000-kw units; two additional units of the same size are on order. Turbine-generators and their related auxiliary equipment are housed in a building with steel framework and reinforced-concrete walls, floors and roof. Four steam generators, each of 400,000-lb-per-hr rated capacity, are now being installed. The front furnace walls form the east side wall of the main building, with



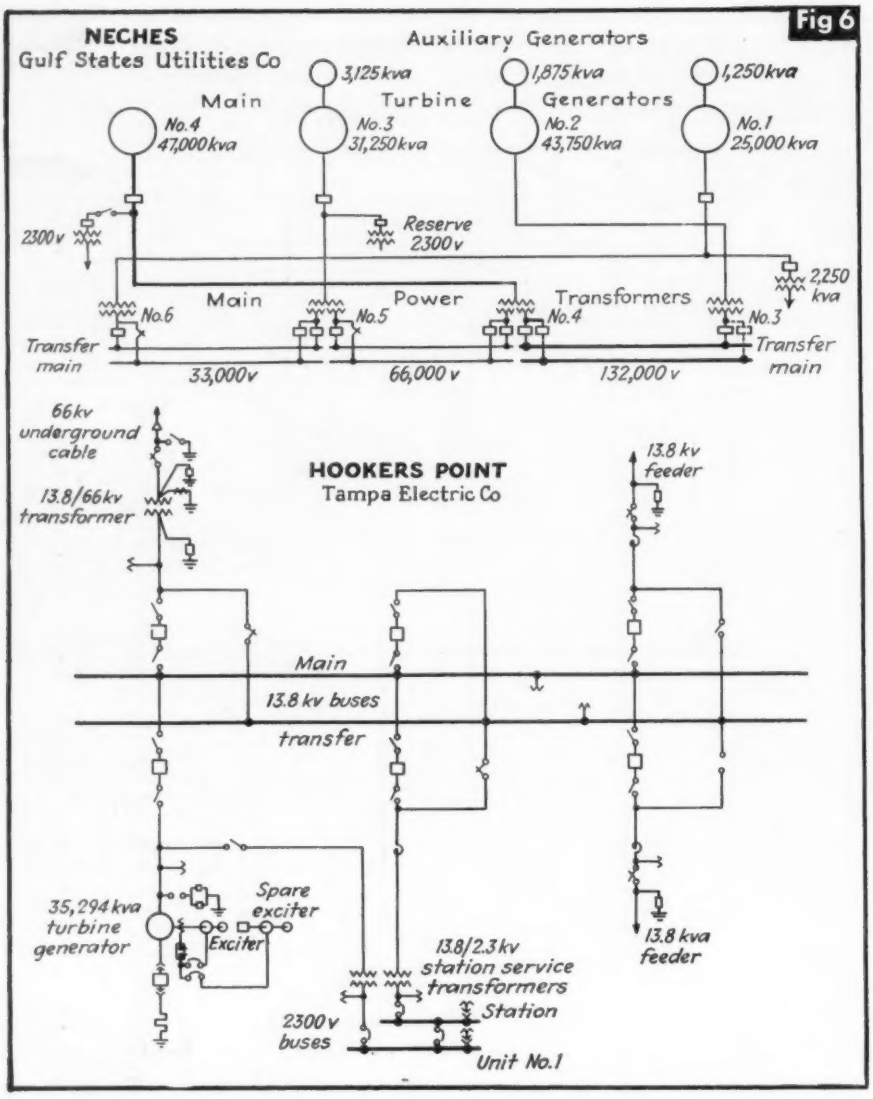
FULL-LOAD HEAT BALANCE for two typical modern installations

the remaining portions of the boilers and boiler auxiliaries outdoors.

While fuel oil will be used, design provides for future pulverized-coal equipment. Water for condensing comes from the Pacific Ocean through 10-ft reinforced-concrete pipes extending about 2,000 ft from the intake forebay. Intake and discharge pipes are connected through a transfer chamber, and a gate arrangement allows alternate use of the two pipes as intake and discharge, making it possible to chlorinate each line from the shore end, thereby minimizing the growth of mussels and other marine organisms.

Fig 5 shows the arrangement of feedwater heating and full-load heat balance for Hookers Point. Extraction steam from four bleed points of the 30,000-kw 850-psi 900-F preferred-standard unit is supplied to two low-pressure closed heaters, to one open direct-contact deaerating heater, and to one high-pressure closed heater. The second extraction point supplies steam to both the deaerating heater and a pair of single-shell evaporators. Condensate from the main condenser passes in turn through an air ejector, two low-pressure closed heaters, an evaporator condenser and the deaerator. This main condenser condensate finally passes through the closed high-pressure heater.

The full-load heat balance of one of the 60,000 kw units at Redondo is fundamentally the same as for Hookers Point with the exception of the addition of a condensate-booster



ONE-LINE ELECTRICAL diagram for two representative modern steam plants. Generator, step-up transformer, and transformer for auxiliaries are a unit

pump and a condensate cooler. A portion of the condensate is pumped through the condensate cooler, the oil coolers and the hydrogen coolers. Use of condensate for cooling turbine lubricating oil and hydrogen necessitates the introduction of a condensate cooler to maintain satisfactory operating temperatures at times of high condensate temperature. After leaving the coolers, condensate is pumped through two low-pressure closed heaters to the deaerator by the booster pump.

In electrical design, a major consideration is initial cost. Maintenance cost and, to a lesser degree, efficiency of equipment should also be considered. There has been some progress in simplification of electrical equipment and greater use of standardized switchgear. Much, however, is left to be done on this subject. Many users insist on variations from standard switchgear which result not only in increased costs but also in too great a delay in shipment. In an endeavor to simplify specifications, greater use has been made of reference to standards of recognized societies to which, in general, manufacturers' standard equipment conforms.

Stations having no outgoing circuits at generator voltage are using a generator and a step-up transformer as a unit, thus eliminating breakers and buses at generator voltage.

The original layout of the Neches Station of the Gulf States Utilities Co had a 13.8-kv bus to which the generators, step-up transformers and a station service transformer were connected through oil circuit breakers. With this arrangement, a transformer could be out of service without decreasing the station output. Rather than extend the 13.8-kv switchgear or make costly changes to it to meet added short-circuit duties, a new generator, its step-up transformer and a transformer for auxiliaries are being made a unit, Fig 6.

The use of station auxiliary transformers connected direct to generator leads adds reliability and reduces costs by omission of a breaker on the high-voltage side. This is less expensive than a shaft generator.

There has been a marked tendency to eliminate oil indoor breakers. It is generally standard practice to specify air circuit breakers for station auxiliaries. For outdoor service, air-operated oil circuit breakers seem to be the prevailing device as they permit fast reclosure and require a low current for closing.

Some plants have adopted a network system for station auxiliaries but we have not been able to prove either the need or economy in its use.

Protection

Bus differential protection is the rule rather than the exception and should be used on metalclad switchgear and on outdoor switchgear using structural-steel supports.

Surge protection is being applied to the main generator in many plants. While generator failures are not frequent, it is believed that the expense of this equipment is justified if for no other reason than it puts added responsibility on the generator manufacturer to furnish a reliable and satisfactory winding.

Direct-connected exciters with pilot exciters are generally used in most power plants. The Redondo has on each of the two 60,000-kw Westinghouse units, a direct-connected 2-stage Rototrol exciter without a pilot, with voltage regulation applied to the control fields of the Rototrol from a static regulator. On each of the two 60,000-kw General Electric units, there will be a direct-connected self-excited main exciter and a separate motor-driven Amplidyne. The Amplidyne bucks or boosts the main exciter field, subject to the control of a static voltage regulator. Two spare motor-driven self-excited units will be provided for the four generators.

VICE-PRESIDENT'S OFFICE has Slimline and regular fluorescents combined for function and decoration. Four different sources of illumination are used. The light output can be adapted to the mood and use required at any particular time

Modern Lighting Meets Functional Needs

N. H. BOYNTON
General Electric Co
Nela Park, Cleveland, Ohio

Four basic patterns for planned relighting of executive offices—Light output is related to type of work performed

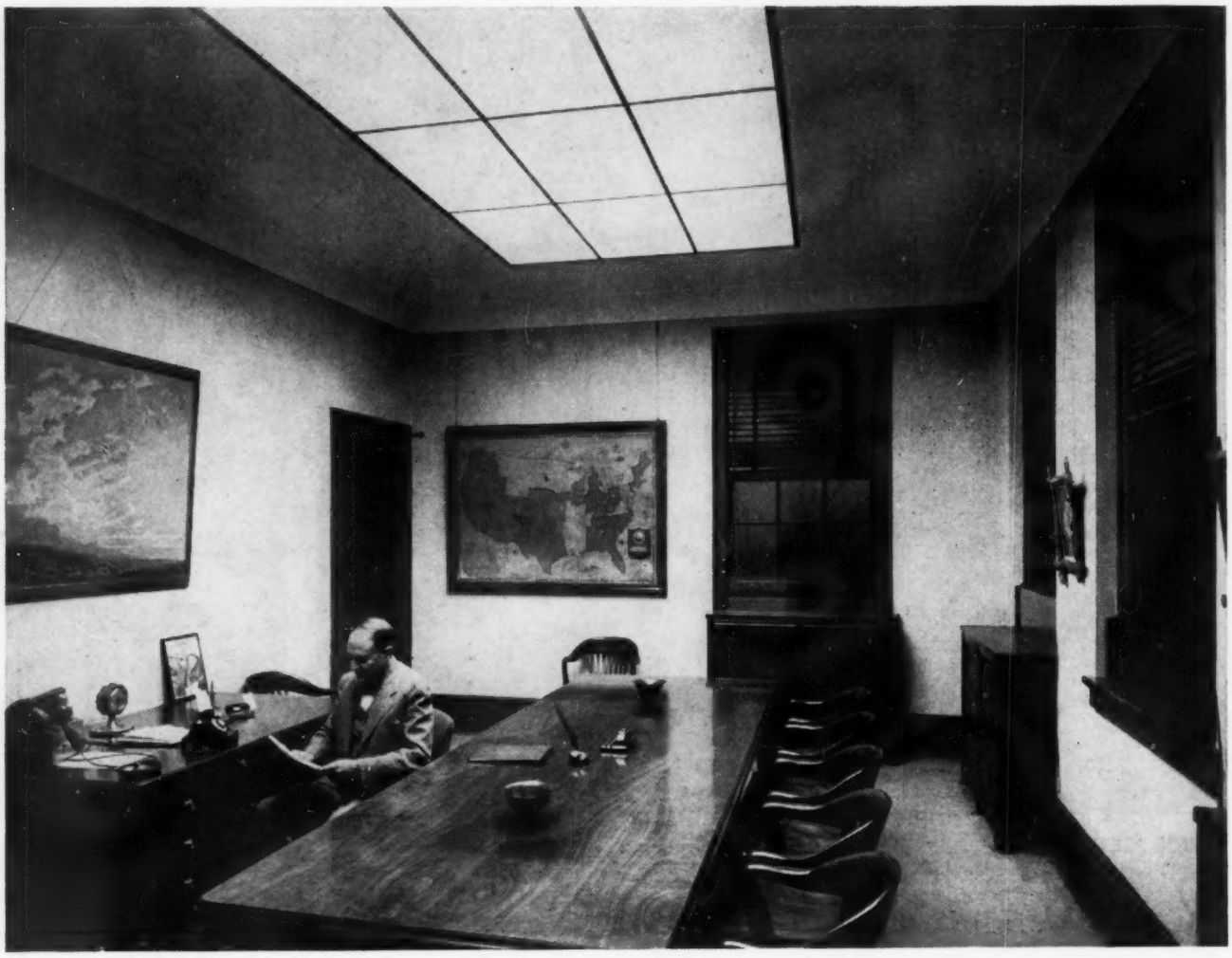
THE OFFICE MARKET is second only to retail stores as an opportunity for lighting sales. The number of potential prospects for office lighting is larger than any other single group. When the size and variety of this market is considered, its tremendous sales opportunities become at once apparent.

An estimated 350,000 offices, outside of stores and factories, contain a total area of three-quarters of a billion square feet, and embrace business operations, professional services and public agencies of every type. In these offices, paperwork, routine, accuracy, speed and personnel morale are directly affected by the type of lighting used. Most of these offices are housed in older buildings and a large percentage are lighted with equipment that is either inadequate or completely obsolete.

The relighting of offices has proceeded more slowly than that of stores and factories. Lighting salesmen and consultants have had little opportunity to see many outstanding office lighting jobs, and even less opportunity to compare a variety of model office installations. Because of the many fluorescent applications possible, new office installations can do little more than give an incomplete picture of the striking possibilities of new light sources. They can, however, suggest a few of the basic patterns that will be followed in office lighting of the future.

The accompanying photographs of relighted executive offices at General Electric's Nela Park show the progress made in solving typical office lighting problems. In each of these, the pattern of lighting is related to the type of work performed. As utility men, contractors, wholesalers and their representatives meet similar problems in the field, ideas suggested by installations such as these will prove of value.

The vice-president's library-office shows a combination of general-line and Slimline fluorescent units that achieves decorative effect and functional value. Four different sources of illumination are used. The light output can be adapted to the mood and use required, whether for conversation, conference or exacting vis-



SALES MANAGER'S OFFICE has ceiling panel of Slimlines that provide 200 ft-c. Lighting is geared to main type of work generally handled. Eye comfort and smoothness are the main considerations in planning lighting installations of this type

SMALL PRIVATE OFFICE relies on Circlines and Slimlines for light to 100 ft-c. This pattern is adapted to serve exacting decorative and functional requirements

ual tasks. Over the desk, a flush panel of lightly etched plastic tiles shields six 40-w tubes. These are completely shielded lengthwise to 45 deg. Through separate switching, two tubes for each step, footcandle values of 25, 40 and 70 can be provided on the desk top.

A second important element in the lighting of this library office is the narrow, flush, ceiling-band of light. This installation houses pairs of 42-in. Slimlines in metal parabolic reflectors. This reflector scatters very little light, and is comparatively easy to shield. Very slightly diffusing material covers the opening. Low brightness is attained by shielding to 60 deg with parabolic reflectors and low diffusion cover plates. Improved brightness distribution is achieved where the wall and ceiling meet. This area, frequently the darkest part, reflects new light and interest.

The portable lamp combines a 12-in. Circline with the conventional three-way filament bulb. This provides 50 ft-c and adds to the atmosphere of dignity and charm.

The walls containing exterior windows provide additional artificial light. The upper halves of the windows house shallow white-lined boxes, painted on the outside to suggest half-drawn shades. Each serves as a lighting fixture with four 42-in. Slimlines running crosswise. Light can be regulated by changing the venetian blinds from closed to open positions. This light source provides a diffusion of simulated daylight.

The lighting of the sales manager's office is geared to the type of work handled in an office of this type. Eye comfort and smoothness are the major considerations. One lighting level is needed during interviews and conferences, another of higher level for exacting visual tasks. This single installation meets these requirements.

SEMI-PRIVATE OFFICE uses 24 regular fluorescents in louvered luminaires that provide a uniform and diffused illumination of 50 ft-c. The total lamp wattage is 960, and the over-all wattage, including ballast losses, is 1,300. Office measures 275 sq ft

The ability of Slimline lamps to achieve large-area, low-brightness, foot-candle values is demonstrated. The lower range is fixed at 100 ft-c, approximately double the top level of most modern office installations. For more difficult seeing tasks, a switch for 200 ft-c is installed. At its maximum foot-candle value, there is no undue brightness, excessive glare, or visual discomfort. An indication of the success of this installation is found in the fact that it is almost always operated at its maximum light output. Neither the occupant nor visitors are ever aware of the light source.

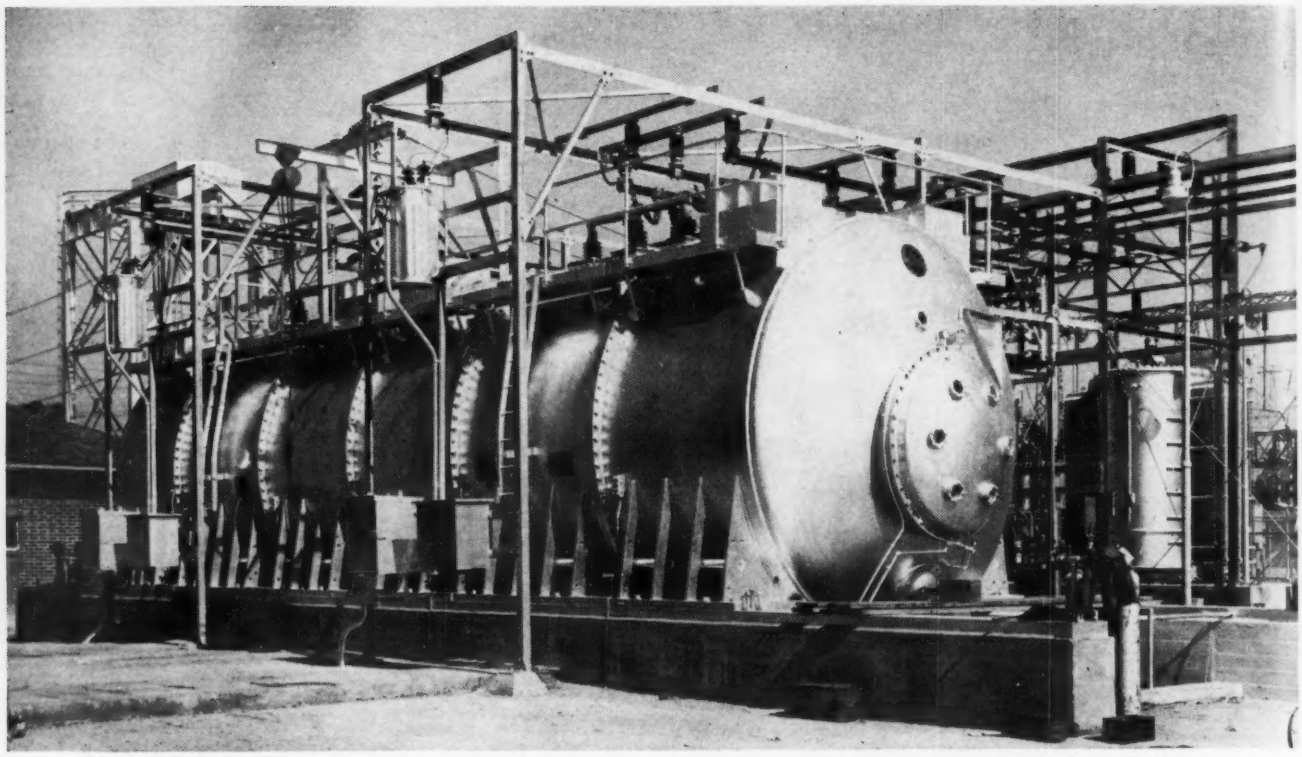
These results are achieved in a room of 326 sq ft with a single ceiling installation of skylight type, $6\frac{1}{2}$ x $14\frac{1}{2}$ x 1 ft. The over-all fixture area of 94 sq ft is shielded by diffusing glass. A total of 52 instant-start 6-ft, 4,500-deg, white Slimlines are used to provide a total lumen value of 117,000, or 369 per sq ft. These are operated on a current of 200 ma or 38 w per Slimline. The total installed lamp wattage is 1,975, an average of 6 w per sq ft. Including ballasts, the installed wattage is 2,600, or 8 w per sq ft. Lamps and luminaire are serviced from above.

A private and semi-private office were relighted as shown, one with standard fluorescent, and the other with a Slimline Circline combination.

In the private office, a room of 190 sq ft, high lighting levels are provided by twelve 8-ft and twelve 6-ft Slimlines. These are housed in a ceiling mounted luminaire with one Circline in each of the corner boxes. Even light distribution results with 100 ft-c on the desk surface. Total watts are 1,200, and the over-all wattage is 1,500 including ballast losses. Lamps are instant-start, 4,500-deg white Slimline. This use of new light sources suggests a practical and pleasing installation-design by which high foot-candle values can be reached in private offices of average size. The pattern can be adapted to smaller private offices to serve exacting decorative and functional requirements.

For the relighting of a semi-private office of 275 sq ft, 24 instant-start, 40-w fluorescent lamps are effectively used. The total lamp wattage is 960, and the over-all wattage, including ballast losses, is 1,300. Louvered luminaires provide a uniform and diffused illumination of 50 ft-c.

These data and illustrations suggest ways in which four offices of different size and character can be lighted. The planning of each installation revolved around the kind of work done in the individual office. Those who planned these layouts had no thought of finding a single ideal solution for each problem. There are many other possible designs, the variation limited only by creative imagination.



FREQUENCY CHANGER SET at Highgrove substation of Southern California Edison Co, where latest application of Amplidyne field control gives quick response and better voltage regulation. The set is rated 60,000 kw

Amplidyne Gives Quick Response on Synchronous Condenser Fields

J. H. VIVIAN and F. V. GILLUM*
Southern California Edison Co
Los Angeles, Calif.

Initial installation on large synchronous condenser encourages further applications, including generators . . . Permits use of small rheostats and control networks; greatly improves voltage regulation

IN A FURTHER QUEST for finer regulation and quicker response in field control for large rotating machines, Southern California Edison Co two years ago made a trial installation of an Amplidyne voltage regulator on a 50,000-kva condenser at Laguna Bell substation. The installation has been satisfactory in its accuracy, reliability, speed of response, simplicity, and freedom from excessive maintenance. Shortly after this installation, additional applications were made on both ends of a 60,000-kva frequency changer at Highgrove Station, which receives 60-cycle power from a third Hoover Dam line. More installations are planned, among them two new 60,000-kw generators in the company's Redondo steam plant, and an existing 100,000-kw generator at the Long Beach steam plant.

Characteristics of the equipment are suited to the requirements of a good voltage regulating system. Primary function of such a system is to maintain desired voltage level under normal fluctuations of load requirements; under normal switching involving sudden large changes in kilovar demand; and under short-circuit conditions and the period immediately following clearing of the fault. In normal operation, the condenser at Laguna Bell is connected through its bank of transformers to the 66-kv station bus. The bus must be maintained at the prescribed voltage level. Record of operation of this system shows the following satisfactory performance:

1. Normal load needs have required the No. 4 synchronous condenser to operate over a range of 34 percent buck (under-excited) to 102 percent boost. This range of kilovar requirements has maintained a bus voltage of 67 kv at midnight to 68.5 kv during the daytime load period.

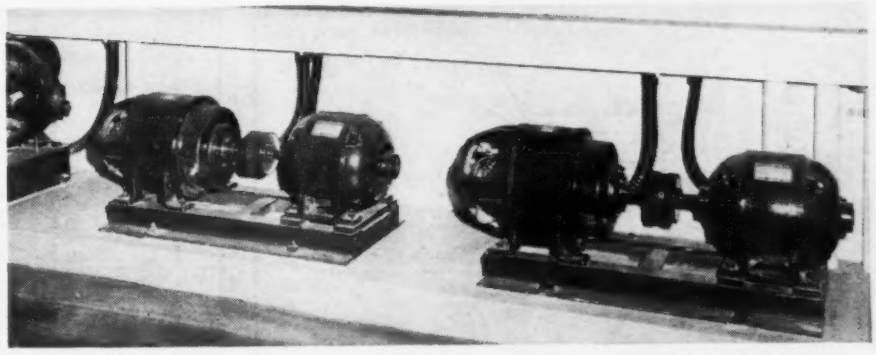
* Electrical and Mechanical Maintenance Engineer and Supervising Relay Engineer, respectively.

This change in voltage is not caused by the regulator. It is an operating voltage schedule that requires a change in voltage level of 500-v steps at certain prescribed hours. Recording voltmeter charts supplement the operator's periodic meter readings and indicate practically perfect regulation. However at locations such as this the load changes are mostly gradual. Recording kilowatt meters show less than 1 percent swing in kilowatt demand.

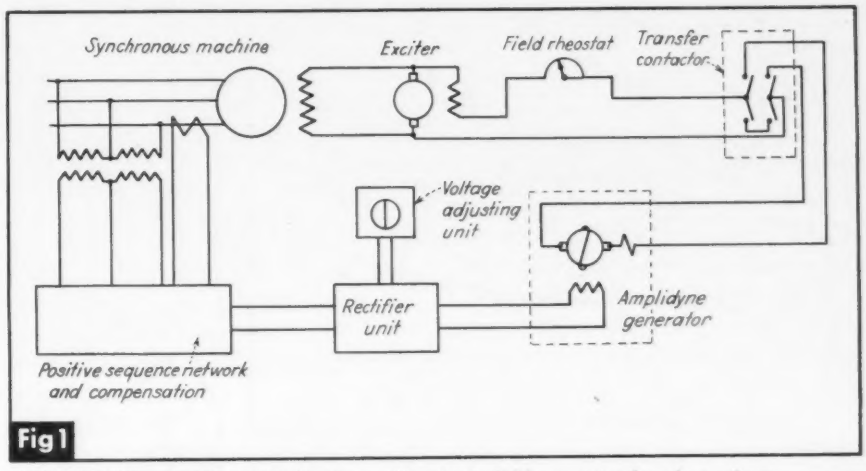
2. Tests were made to determine response under switching of the large 220-kv to 66-kv power banks, the most severe condition except severe short circuits. A demand of 33,000 kvar was suddenly applied, causing a 6 percent dip in voltage. The Amplidyne responded instantly, but due to time lag of the exciter and the synchronous condenser the voltage required 8 sec to return to normal. A demand to reject 33,000 kvar was then made. This resulted in a 4 percent rise in voltage, which returned to normal in 11 sec. There was no hunting in either of these experimental cases.

3. During the period the Amplidyne has been in service, there have been several severe 66-kv faults on the transmission system served by Laguna Bell. These ranged in distance from the station up to three or four miles. One was phase-to-phase, others were flashovers of 2,000 to 3,000 recorded amp ground current. Recorded voltage dips were 10 to 40 percent. Over-all operation of the Amplidyne regulating equipment was satisfactory, voltage returning promptly to normal after trouble was cleared, with no apparent overshooting of voltage. It is the practice of this utility to relay the synchronous condenser equipment on a 5 percent dip in system frequency.

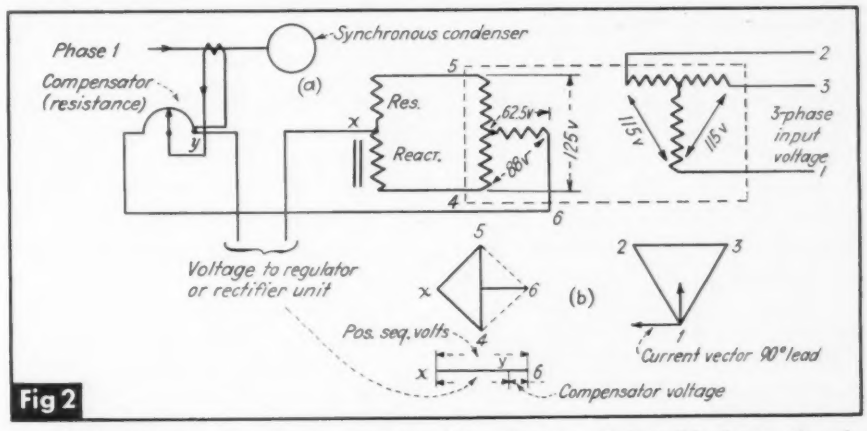
In addition to giving good regulation, a voltage regulator must satisfy the following requirements: (1.) Adjustment of voltage level must be simple and made easily even by an inexperienced operator; (2.) range of voltage level adjustment must be adequate to meet all requirements of daily voltage schedules; (3.) a simple means should be provided to transfer the excitation system from regulator to manual control or vice versa rapidly and with a minimum of disturbance to the machine load or



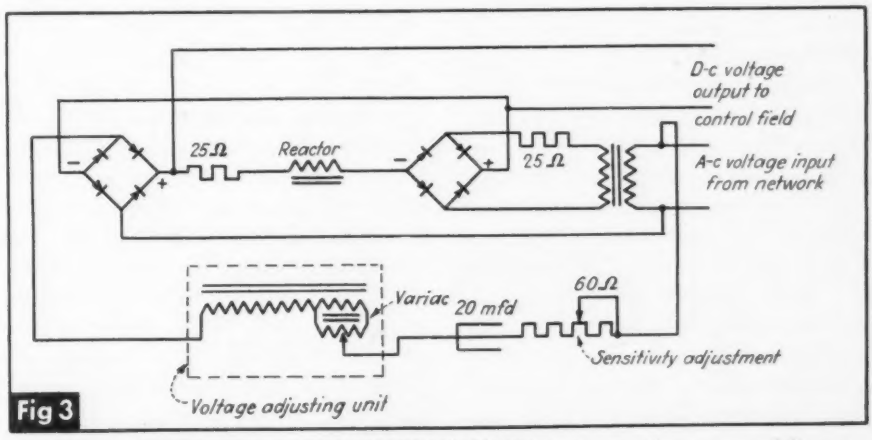
GENERAL SCHEME of supplying Amplidyne showing the five main elements



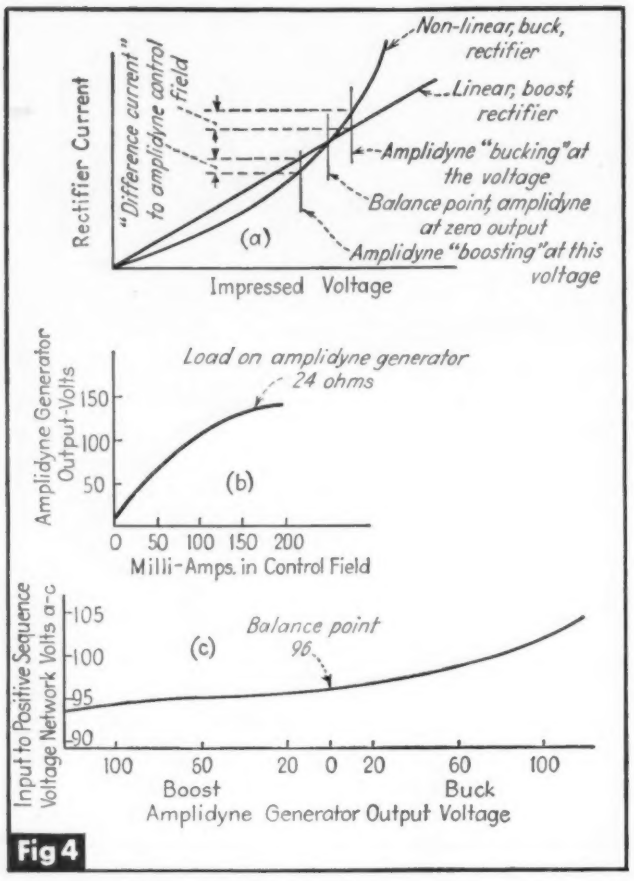
AMPLIDYNE GENERATOR SETS modify shunt field current of main exciters



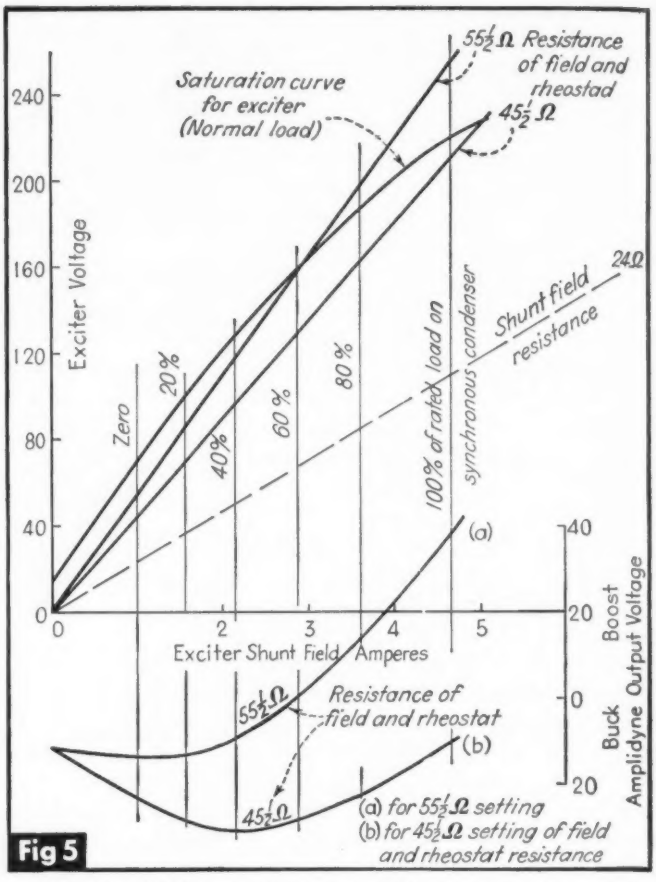
TRANSFORMER and network connections (a), and vector relations (b) of network and compensator voltages



COMPENSATED POSITIVE SEQUENCE VOLTAGE is impressed upon two full-wave rectifiers as here shown



PERFORMANCE CURVES of Amplidyne generator provide graphic analysis of units' operation



TYPICAL CURVES showing how Amplidyne output voltage must vary for every setting of the shunt field rheostat

voltage; (4.) operating condition of the regulator should be indicated at all times; (5.) operation should be reliable and it should not be necessary to take the regulator out of service frequently for maintenance; and (6.) a simple means to reverse exciter polarity may be included, since it is often desirable to change the polarity of the collector rings of the synchronous machine.

Many types of voltage regulators are in service today. Until recent years synchronous machines used on power systems were equipped with vibrator-type regulators. These have given excellent service and are widely used. System growth and interconnection required better regulation. This resulted in a regulator operating from positive sequence initiation, with slow response elements actuating a motor rheostat for normal operation and quick response elements operating for abnormal conditions. Electronic regulators having instantaneous response, no moving parts and very sensitive regulation have also been devised.

Recently small d-c generators with special inherent regulating characteristics have been adapted to function as exciters or pilot exciters. Known by trade names of Amplidyne, Rototrol, or Regulex, all have the same basic theory of operation, although they differ in detail. Operating experience of Southern California Edison has been exclusively with the General Electric Amplidyne. For the theory of the Amplidyne, see ELECTRICAL WORLD Engineering Reference sheets, May 1 and May 15, 1943.

Application of Amplidyne control to this type of equipment is relatively simple. Essentially, the Amplidyne is a sensitive and quick-acting means of increasing or decreasing field excitation and output of the main exciter. As shown in Fig 1, there are the following five main elements:

1. Positive sequence network supplies the input signal to regulator. This is shown in Fig 2a (with vector relations in Fig 2b) as a small three-phase, T-connected transformer with secondary connections through a resistor and reactor. Acting in conjunction with a current compensating circuit, this network supplies a voltage which is a true reflection of positive sequence voltage existing at high-voltage terminals of the transformer bank for the main machine. For applications to generators and frequency changer sets, it is necessary to replace the simple resistor compensator with one containing variable resistance and variable reactance.

2. Rectifier unit (Fig 3) changes a-c signal from the network to d-c and from it supplies field excitation to the Amplidyne. Input to bridge on right is in series with plain resistor; output is linear function of machine voltage. Acting alone, this output would boost the Amplidyne output voltage. Bridge on left is in series with voltage adjusting unit, has non-linear characteristic. Acting alone, it would decrease, or buck Amplidyne field and output voltage. These two rectifier bridge circuits are connected differentially. Thus net output is difference between currents they carry, as shown in Fig 4a.

3. Voltage adjusting unit (Fig 3) is a combination of saturating reactor and variable reactance. Non-

linear impedance characteristic is due to magnetic saturation of iron core. The unit is adjusted by turning control knob of a small auto-transformer of "Variac" or "Power-Stat" type. This changes the point of intersection of the two impedance curves (Fig 4a) and permits a smooth range of adjustment of about plus or minus 5 percent in Amplidyne voltage output.

4. Amplidyne itself is a 3-kw machine driven by a direct-coupled, 5-hp, 220-v, 3-phase motor. Special design gives quick response and large amplification for changes in excitation of its main control field or its minimum excitation field. Fig 4b and 4c show typical output voltage of Amplidyne as determined by field excitation, or more significantly by voltage input to positive sequence network.

5. Transfer and regulator control switch has "Off-Test-On" positions and incorporates circuits necessary to change from manual to automatic control, or vice versa.

Equipment Operation

Operation of the equipment is simple. With the control switch in the "off" position, the main exciter shunt field is entirely controlled by a hand rheostat like any normal shunt machine. Amplidyne is stopped and its control circuits disconnected. Three steps, which may be made with any load on the synchronous machine, are necessary to go to Amplidyne regulation. These steps are as follows:

1. Operator puts control switch in "Test" position which starts Amplidyne motor generator set and sets up its control circuits. Three-phase voltage from the output of the main generator is changed to single phase, then rectified to supply excitation to the Amplidyne field. Resultant output voltage of the Amplidyne is tested for full range of 250-v buck to 250-v boost on a 250–0–250-volt instrument by operating the voltage adjusting unit labeled "Ampl. Rheo."

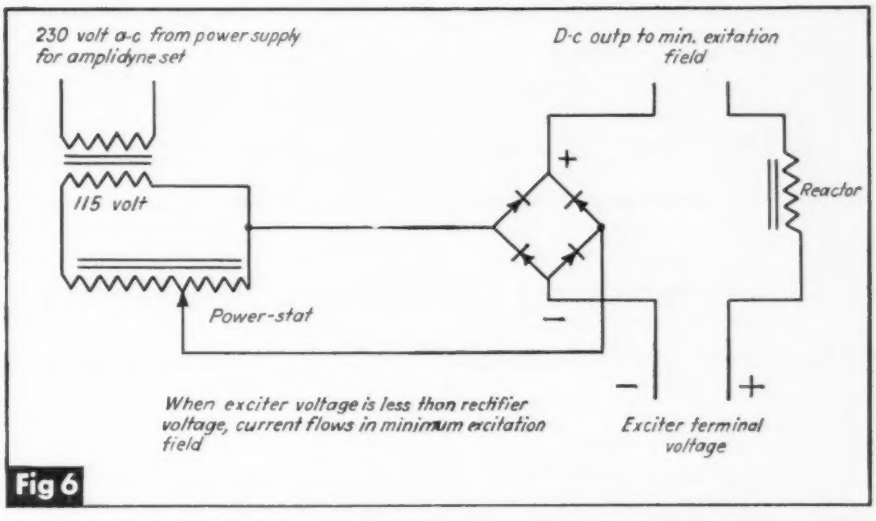
2. Operator brings Amplidyne voltage to zero, then turns control switch from "Test" to "On," putting Amplidyne in control.

3. Operator changes setting of exciter field rheostat to adjust Amplidyne output voltage to an optimum value with respect to machine load at the time. The curves of Fig 5 are typical and show the change in Amplidyne output voltage with machine load for the different settings of exciter field rheostat. When Amplidyne output voltage is adjusted to a point between curves (a and b of Fig 5) then failure of the Amplidyne or the holding coil on the transfer switch contactor will mean that the main unit will continue to operate at some point between 60 and 105 percent of its rating, depending on setting of the rheostat.

To return to manual control, the exciter field rheostat is adjusted to bring Amplidyne voltage output to zero, and the control switch turned to "Test" or "Off."

The net excitation on the Amplidyne field (as shown in Fig 4a) is the difference between a linear and an adjustable non-linear rectifier circuit so connected that as the bus voltage being regulated changes, excitation on the Amplidyne changes by an amount necessary to return the bus voltage to normal.

Refinements have been added to this basic function. To prevent unstable operation or hunting, a stabilizer is used. Response of the Amplidyne to change in system conditions is practically instantaneous. But inherent time lag in exciter response and response of the synchronous machine to change in excitation requires a stabilizer to minimize overshooting when sudden changes occur. This stabilizer is a specially designed transformer with primary connected across the exciter voltage and secondary in series with the Amplidyne control field. Sudden change in exciter voltage induces an opposing voltage in secondary of the stabilizer. This produces a damping action on the control field.


230 volt a-c from power supply for amplidyne set
D-c outp to min. exitation field
115 volt
Reactor
Power-stat
When exciter voltage is less than rectifier voltage, current flows in minimum excitation field
Exciter terminal voltage
Fig 6

MINIMUM EXCITATION circuit which prevents Amplidyne from reducing shunt field excitation to or reversing it under conditions of abnormally high voltage when synchronous condenser is operating underexcited

No limit is placed on over-excitation. But to safeguard the synchronous machine against continuous overload during extended periods of abnormally low system voltage, a simple induction-type overload relay is placed in the current transformer circuit. This is set to operate an annunciator if a 10 percent overload exists for longer than 10 sec.

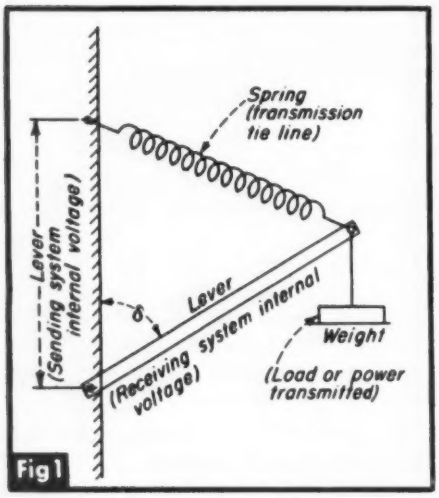
Frequently, a synchronous condenser operates under-excited. To insure that the Amplidyne will not reduce excitation to zero or even reverse it during periods of abnormally high voltage, the regulator incorporates a minimum excitation circuit. This is shown in Fig 6. This circuit energizes another separately wound field in the Amplidyne to boost its voltage output when exciter voltage drops below desired minimum—25v on the condenser at Laguna Bell and the frequency changer set at Highgrove.

Another refinement is a field-reversing control which allows polarity of the slip rings to be reversed without affecting any other function of the equipment. On synchronous condensers this serves only to equalize wear on rings and brushes. But on frequency changer applications it provides a convenient means of slipping poles to permit paralleling.

HOW

DESIGN • CONSTRUCT • OPERATE • MAINTAIN

Presenting Calculating Board Power Swing Curves

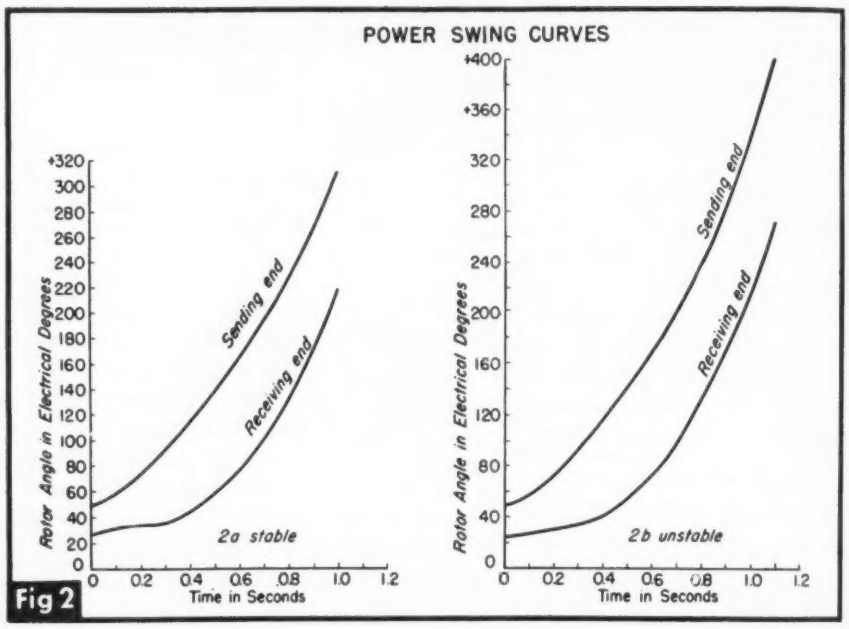


MECHANICAL ANALOGY of a long transmission line connecting two machines or power systems

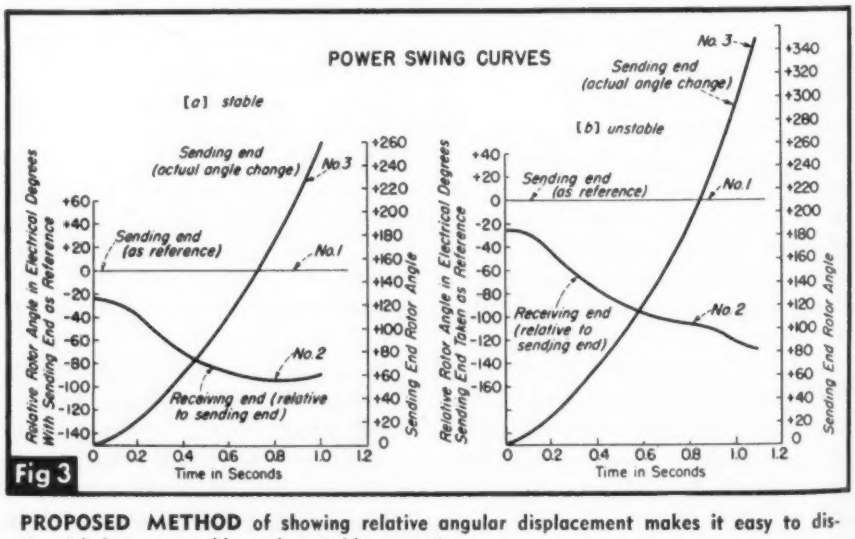
W. A. MORGAN
U. S. Bureau of Reclamation
Denver, Colo.

MOST IMPORTANT CONSIDERATION in studying power system stability is a comparison of power swing curves of the system at each end of the transmission line. Such a system can be compared to the mechanical analogy shown in Fig 1. The receiving system and its load are shown as a lever and weight, supported by a spring representing the transmission line. Angle between sending and receiving system is increased by adding load up to the limit of stability. When this limit is reached, the angle continues to increase without any increase in load carrying ability and the system is unstable.

Common method of analyzing a-c calculating board studies of power system stability where system voltages are rotating is to compare their positions as they rotate. Fig 2a and 2b illustrate the difficulty of determining by visual inspection whether the relative angle between these voltages is increasing or decreasing.



COMMON METHOD of showing absolute angular displacement of equivalent sending and receiving ends during system disturbance. Distinction between stable and unstable operation as shown by increase or decrease of distance between curves is obscured by their similarity


POWER SWING CURVES
(a) stable
(b) unstable
Sending end (actual angle change)
No.3
Sending end (as reference)
No.1
No.2
Receiving end (relative to sending end)
Relative Rotor Angle in Electrical Degrees With Sending End as Reference
Relative Rotor Angle in Electrical Degrees Sending End Taken as Reference
Sending End Rotor Angle
Time in Seconds
Fig 3

PROPOSED METHOD of showing relative angular displacement makes it easy to distinguish between stable and unstable operation

Proposed method of showing relative position of these same voltages is shown in Fig 3a. The internal voltage of sending end is plotted as horizontal straight line (curve No. 1), and serves as reference for receiving end voltage (curve No. 2). This gives the effect of a stationary reference. It is immediately apparent that the system is stable since the angle has reached a maximum and is decreasing. Fig 3b, where the angle is steadily in-

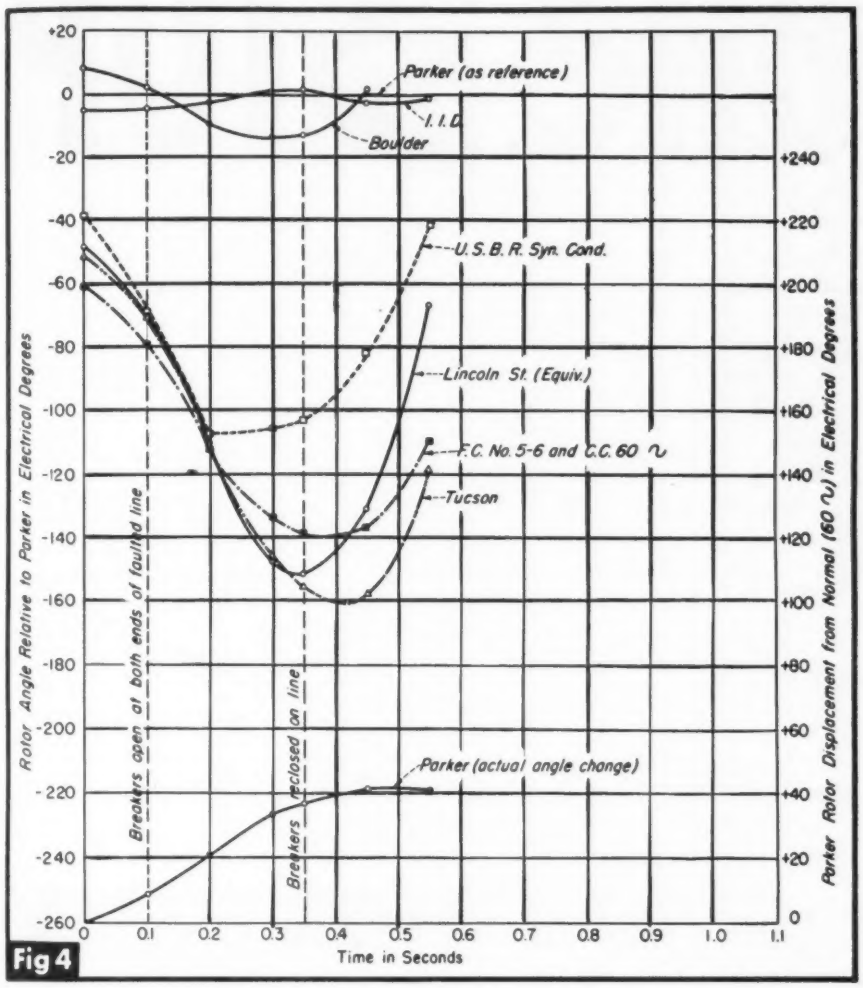


Fig 4

EXAMPLE OF PROPOSED METHOD for presenting a-c calculating board power-swing curves

creasing after one second, is just as obviously unstable. Actual position of the reference voltage at all times is given by curve No. 3. But this is not necessary to establish stability of system. Application of this method to an actual case, Fig 4, shows clearly that all units on the system are stable.

Since the angular displacement between curves must be measured by the method shown in Fig 2, this proposal represents very little additional effort. The added clarity in showing this displacement is well worth while.

• • •

Ruben Alkaline Dry-Cell Details Now Disclosed

HELD a close secret during the war —and a cause of many unfounded rumors—was the dry-cell patented in 1942–47 by S. Ruben and made by various manufacturers under license from P. R. Mallory & Co Inc. The details of composition of this new cell have been disclosed in a paper by Friedman and McCauley at the recent meeting of the Electrochemical Society in Boston.

The Ruben cell comprises the electrochemical system $Zn|Zn(OH)_2$ KOH aq. HgO (solid)|Hg and has a rated capacity of 200 milliampere-hours for each 1.6-gram unit of active material. The open-circuit voltage of the cell is nominally 1.34 and the initial closed-circuit voltage under normal loads varies from 1.24 to 1.31 v. depending on the load applied. The discharge curves obtained on normal drains are substantially flat, thus insuring reasonably uniform voltage output. The utilization of active materials is approximately 80 percent to 90 percent and is extremely efficient compared with other types of commercial dry cells. Service obtainable under high-current drains is approximately 4 to 7 times that of conventional dry cells of equivalent volume when discharged to the usual cutoff potentials of 0.75 to 1.0 v. The roll anode cell structure was the first design to go into large scale production, the entire output having been allocated to the armed forces during the last war. The pressed powder anode cell, which incorporates such improvements as additional volume reductions for given watt-hour capacities, may supplant the roll anode cell for commercial applications. These new designs, although still failing to bring the cost of the Ruben cell down to that of conventional dry cells, will offer a distinct advantage when considered from a cost/service ratio. The development of improved production methods will make it commercially competitive, particularly for applications where its small space requirements, long service performance and flat voltage discharge characteristics are important factors. Shelf-life is good.

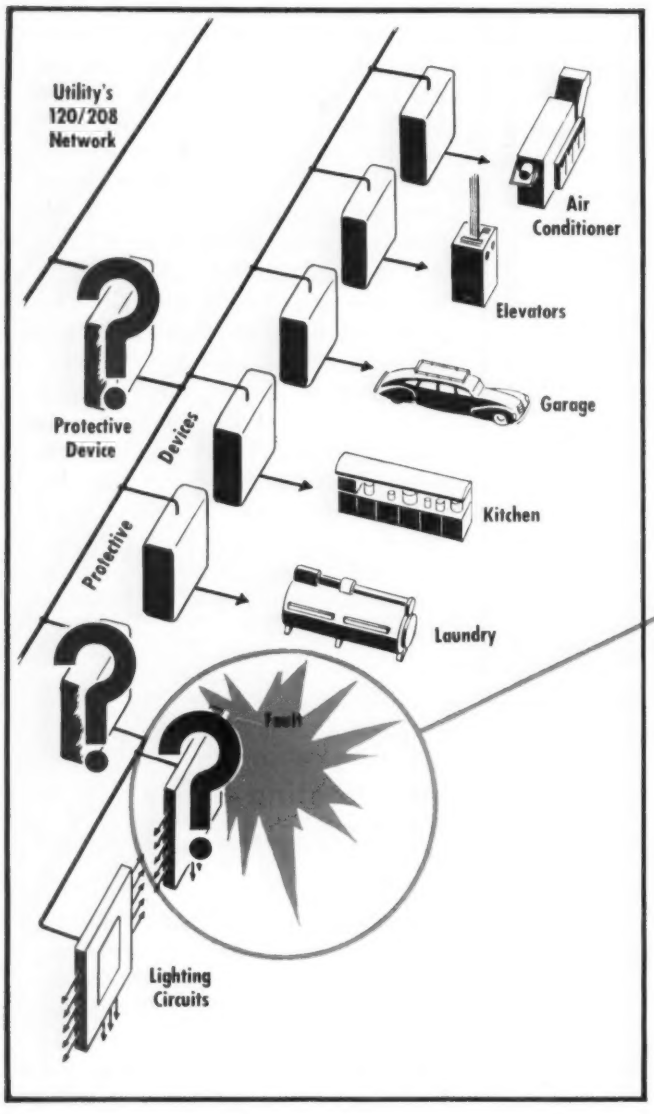
•

Investigating Fires On Customers' Premises

SYSTEMATIC INQUIRY of fires on customers' premises is an important routine in an eastern utility. Reports of all bell alarms are received and recorded at the principal substation. Each alarm or recall is telephoned to a trouble desk, and the box number, location, character of alarm (first, second, etc) given. Fire alarm box locations are listed by the operating department. Each box requiring response by an emergency man is so marked on this list. An emergency man is required to respond to a second alarm from any box.

On report of an alarm, the operating department checks the box location to determine if an emergency man is to be sent. This individual follows up the emergency and reports on same. After the recall, the operating department correlates the information obtained and completes the in-

COULD YOUR PROTECTIVE DEVICES..... STOP



Because of the high kva capacity of a network system, bad shorts may draw tremendous surges of current that may blast protective devices of inadequate "IC." Loss of power to all facilities may result; equipment and personnel may be endangered by flying metal and fire. G-E air circuit breakers afford adequate "IC" protection, isolate shorts at their source, and do away with the possibility—and hazard—of over-fusing. Also, all costs of replacing fuses are eliminated. Be sure to check with your nearest G-E sales representative for complete information before installing protective devices on installations fed by a network system.

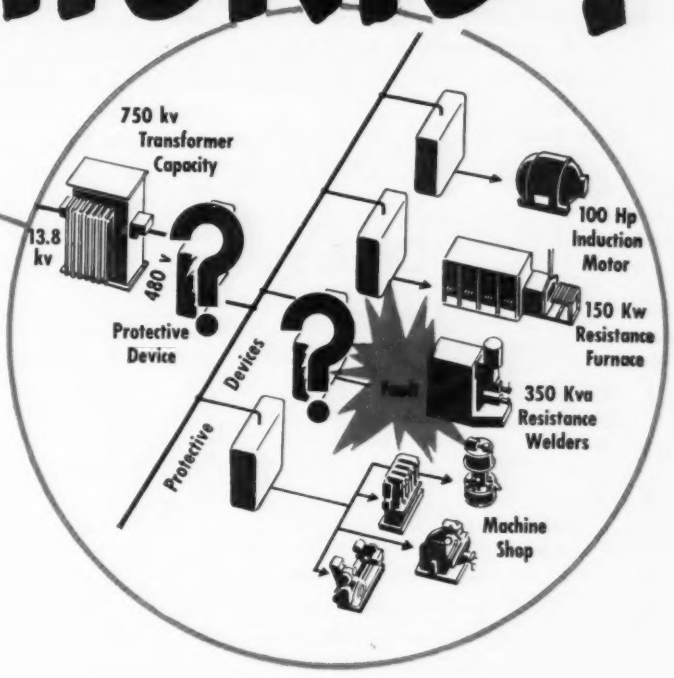
. . . PREVENT

You're gambling with production, equipment, and personnel if your protective devices have inadequate "IC." Inadequate "IC" means that the device, whether it's an air circuit breaker, fused knife switch, or oil circuit breaker, is unable to handle the full short-circuit currents available on a low-voltage system. Under such conditions devices may fail, resulting in costly power shutdowns and loss of protection, besides hazards to personnel. Be sure of your "IC." Here's how . . .

KNOW THE "IC" of your low-voltage protective devices. The interrupting capacity of a circuit breaker or other protective device is the maximum current it is rated to *adequately* interrupt.

BE SURE THE "IC" IS ADEQUATE to interrupt maximum short-circuit currents. Maximum short-circuit current is *not* determined by the normal load on the circuit. The total capacity of the transformers feeding the circuit is the critical factor. In the adjoining table, check your transformer capacity against the "IC" corresponding to your particular circuit voltage. The interrupting capacity of your protective devices should be equal to or greater than the short-circuit currents available as determined by your transformer capacity.

THESE SHORTS ?



That protective device ahead of the fault should have an "IC" (interrupting capacity) rating of 25,000 amperes. Anything less* can mean danger in the form of a destroyed device, flying metal, or possibly flaming oil. If the protective device on the branch feeder explodes or fuses together because of inadequate "IC," it means a power shutdown in the entire plant with consequent production losses. If your installation is similar to the one shown, refer to the table below and check the "IC" of *your* protective devices.

*Some fused knife switches and oil circuit breakers may have a maximum "IC" of only a few thousand amperes.

POWER SHUTDOWNS

INSTALL G-E AIR CIRCUIT BREAKERS if you need more "IC." It's easy to select the proper G-E air circuit breaker from the table. And you can be sure they have adequate "IC" to safeguard your production, equipment, and personnel. By providing three-phase interruption of dangerous overcurrents, G-E breakers eliminate the possibility of single-phasing damage to motors. Workmen can operate these breakers easily. A turn of the handle and power is restored—no parts to be replaced.

WRITE FOR THESE BULLETINS on G-E air circuit breakers, or contact your G-E sales representative. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

GEA-3600 AE-1 Air Circuit Breakers
GEA-3642 AL-2 Air Circuit Breakers
GET-1113 Selection and Application of Breakers
GET-1233 Short Circuit Currents in Industrials
GEA-2596 Low-voltage Drawout Equipment
GEA-3592 Load-center Unit Substations

INTERRUPTING RATINGS—G-E AIR CIRCUIT BREAKERS TO USE

Transformer Capacity in Three-phase Kva	220-240 CIRCUIT VOLTAGE				440-480 CIRCUIT VOLTAGE				550-600 CIRCUIT VOLTAGE			
	Main Breaker		Branch-feeder Breaker†		Main Breaker		Branch-feeder Breaker†		Main Breaker		Branch-feeder Breaker†	
	"IC"	Breaker to Use	"IC"	Breaker to Use	"IC"	Breaker to Use	"IC"	Breaker to Use	"IC"	Breaker to Use	"IC"	Breaker to Use
300	50,000	AL-2-50	25,000	AE-1-25	25,000	AE-1-25	15,000	AE-1-15	25,000	AE-1-25	15,000	AE-1-15
500	50,000	AL-2-50	50,000	AL-2-50	50,000	AL-2-50	25,000	AE-1-25	25,000	AE-1-25	15,000	AE-1-15
750	75,000	AL-2-75	50,000	AL-2-50	50,000	AL-2-50	25,000	AE-1-25	50,000	AL-2-50	25,000	AE-1-25
1000	75,000	AL-2-75	75,000	AL-2-75	50,000	AL-2-50	50,000	AL-2-50	50,000	AL-2-50	50,000	AL-2-50
1500	....	....	....	....	75,000	AL-2-75	75,000	AL-2-75	50,000	AL-2-50	50,000	AL-2-50
2000	....	....	....	....	100,000	AL-2-100	100,000	AL-2-100	75,000	AL-2-75	75,000	AL-2-75
2500	....	....	....	....	100,000	AL-2-100	100,000	AL-2-100	100,000	AL-2-100	100,000	AL-2-100
3000	....	....	....	....	....	....	....	....	100,000	AL-2-100	100,000	AL-2-100

Note: This table is based on unlimited power supply and 5 per cent transformer impedance.
†If cascading of feeder breakers is used, it is possible that a smaller breaker may be used for branch-feeder service.

GENERAL ELECTRIC

860-32

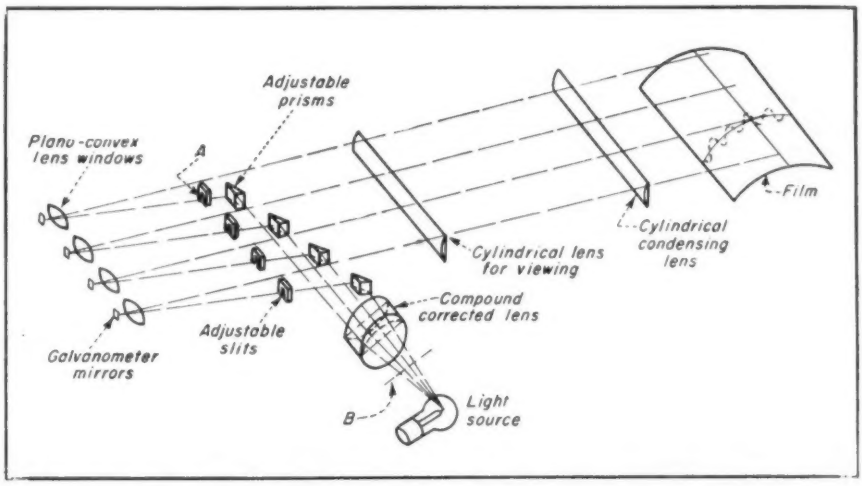
vestigation report. This is sent to the installer in whose district the fire occurred. The customer's damaged premises are then closely inspected. Principal objective is to ascertain any damage to utility property. If such is found, the meter is removed and a complete report made to the meter department.

Whenever any employee is sent to a fire location he makes an independent investigation of a possible electrical origin. Under no condition is he permitted to question fire department men or others on this. He may report conversation overheard, but his own opinion of the cause is desired. The maintenance supervisor personally investigates any fires which the local press claims to be of electrical origin. He reports verbally on this to the distribution superintendent. The maintenance supervisor takes any action he deems necessary to prevent further damage to utility property. Heads of departments are required to aid in this as requested. Fire investigation reports are filed for two months and then the files are destroyed.

• • •

Oscillograms in Color Are Now Practical

C. J. TIRK
Engineering Laboratories and Standards Dept
Westinghouse Electric Corp
East Pittsburgh, Pa.



OPTICAL SYSTEM of a mechanical oscillogram showing proper location of filters for producing oscillograms in color. Up to seven traces each in a separate color have been recorded in this way on a 5 by 11-in. color film

Oscillograms with up to seven traces, each in a different color, can now be produced. This has been developed at the oscillograph laboratory of the Westinghouse Electric Corp. The technique, simple enough for use in the field by amateurs, involves Ansco color film and color filters for the optical system of the oscillograph.

Advantage of colored oscillograms lies in their ability to record more traces on a film of given width without confusion. With each trace a separate color, it is easy to distinguish and interpret overlapping traces. Cost of the film is higher, however, and the time for processing the film is longer. But this may be overcome by saving time in analyzing the record.

For developing the technique, a Westinghouse type PA seven-element mechanical oscillograph was used with a 50-cp automobile lamp as the light source for its optical system, shown. Voltage on the lamp was raised about 50 percent while the film was being exposed. The lamp was focused out to the galvanometer mirrors and then to the film. Length of light travel was about 36 in. from source to moving film through the various lenses and prisms.

Film used was Ansco Color Reversible, tungsten type. A roll film size was selected that would fit the standard oscillogram film holder giving two charts each 5 by 11 in. per roll. The film was specially spooled for the purpose by Ansco, in their Binghamton, N. Y., factories.

Filters used to color the various traces were placed in front of the adjustable slits "A" on the sketch. Individual filters were assembled using various combinations of Ansco colored cellophane printing filters—in some cases as many as four—to give a single color filter. The combinations used are given:

Color	*Ansco C.C. Printing Filters*
1. Green	1—No 24, 1—No 25, 1—No 44, 1—No 45
2. White	None
3. Magenta	3—No 35
4. Cyan	3—No 45
5. Red	1—No 24, 1—No 25, 1—No 34, 1—No 35
6. Yellow	3—No 25
7. Blue	1—No 34, 1—No 35, 1—No 44, 1—No 45

All seven traces can be recorded simultaneously. Best exposure time was 1/5 sec for 11 in. and a writing speed of 240 in. per sec. This gave oscillograms in which the different traces can be easily distinguished. If more elements are to be used on the same size film, it is only necessary to add more colors to be able to distinguish them from each other. If a 12-in. film width were used, for example, it would be possible to get 48 records with eight different colors and have over 2-in. deflection, double amplitude, on each record without interfering with a record of the same color.

No attempt will be made here to outline the film developing procedure since it is thoroughly described in literature available from the film manufacturer. While the developing process is considerably longer than that required for black and white film and involves more steps, it is not beyond the ability of the photographic amateur. The developing procedure has a further advantage that, after partial completion in the field, development can be interrupted and completed in the laboratory at a later date. At this intermediate point in the process, it is also possible to secure a reading by reflected light from the film. This can be done half an hour after exposure.

When development is complete, prints can be made from the film either in color or in black and white.

What's new in GE street lighting

New Hood offers 3 big advantages for low-cost suburban lighting

General Electric announces the new Form 107 Hood for open and enclosed suburban and radial-wave reflectors. Intended primarily for multiple circuits, this modern, die-cast-aluminum hood is interchangeable with most cast-iron hoods, such as the Form 45L design it replaces. The new hood permits higher mounting. It simplifies wiring. And—it gives positive maintenance of proper light distribution.

Thus for the first time you can get a hood that includes all modern features—at a price in line with modern low-cost suburban reflectors.

Features of the Form 107 Hood

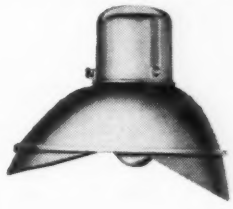
Among the improvements found in this new hood are these:

- Reflectors are attached directly to the hood —an exceptionally neat, attractive arrangement using a minimum of parts.
- More accurate light control with rigid positioning of multiple-lamp light center at 4⅜ *or* 5¼ inches. Uses internal bosses rather than adjustable socket, can't get out of adjustment.
- Greater mounting height and easier wiring with new side-mounting slip-fitter. Top-tapped mounting also available.
- Greatly improved appearance—up-to-date lines, and natural-finish die-cast aluminum.

A. M. Bjontegard, General Electric design engineer, snaps the spun-sealed suburban type CR optical assembly on the new Form 107 slip-fitter Hood.

Part of over-all improvement in suburban luminaires

The new Form 107 Hood is part of General Electric's program of improving suburban lighting equipment—the program that has already brought you the open suburban reflector with asymmetric light distribution at essentially the same price as the old radial-wave reflector, the asymmetric or symmetric "junior" spun-sealed optical assemblies, and the high-efficiency 2-way and 4-way Type VR for long spacing with 4000- and 6000-lumen lamps.



Form 107 Hood for top mounting and Type SO open suburban reflector

GOOD STREET LIGHTING BUILDS GOOD WILL

This improved hood is another of many developments which General Electric has pioneered to help you provide better street lighting at less cost. For additional information call our nearest office or write to *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

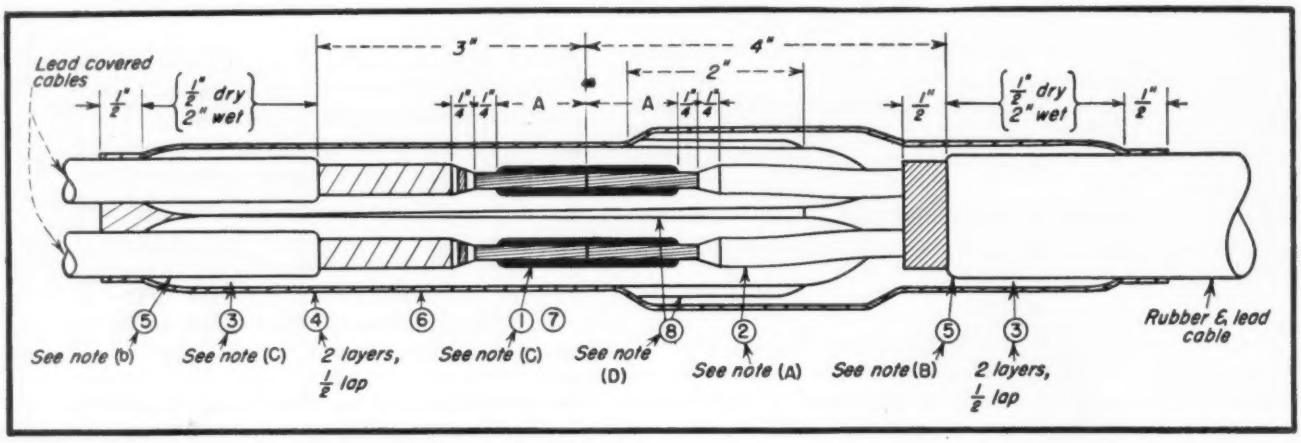
GENERAL ELECTRIC

452-55

Are you tying in with the NEMA plan to give America better street lighting?

How To Joint Two Types Of Lead-Covered, 600-V Cables

A procedure for jointing rubber and lead-covered cable to asbestos, varnished-cambric, lead-covered control cable used in generating stations and substations; instructions comprised of notes, an illustration and bill of material; an adaptation from a standardized method of the Philadelphia Electric Co



OUTLINE with dimensions and note references for making cable joint

Construction Notes

(A) Roughen insulation with rasp. Coat with rubber cement and allow to dry until tacky before applying rubber tape.

(B) Round end and clean lead sheath. Coat with bonding cement and allow to dry until tacky before applying rubber tape.

(C) Starting at the connector, build up the insulation wall of rubber tape to the diameter of the lead sheath on the asbestos, varnished-cambric cable and overlapping the rubber insulation about 1 in. Apply an additional three layers of tape at ½ lap, overlapping the lead sheath of the cable the required distance and the rubber tape an additional inch.

(D) Spread conductors, form a cylindrical roll of rubber putty 2 in. long and place it in the crotch, pressing the insulated conductors against it. Mold putty around the joint until a cylindrical mass 2 in. long is formed. In cold weather, alternately warm with a torch and knead the mass until the whole is vulcanized together forming a watertight seal. Use torch with extreme care.

CAUTIONS

Minimum working temperature of rubber tape is 40 deg F. Do not stretch rubber tape to less than three-fourths of original width. Use pigtail joints or pressed connectors in current transformer secondaries.

Table of Dimensions

Wire Size, AWG or M cm	Dim. "A", inches	
	Soldered	Pressed
10 to 6	3/4	...
2 to 1/0	1	15/16
2/0	1	1
4/0	1 1/4	1
350	1 1/4	2 1/16
500	1 1/2	2 5/16

Bill of Material

Item	Description
1	Pigtail joint [a]
	Solder connector [a]
	Pressed connector [a]
2	Rubber cement
3	3/4-in. rubber tape
4	3/4-in. friction tape
5	Bonding cement
6	Asphaltic paint
7	Rosin core solder [b]
	Stearic core solder [b]
8	Rubber putty

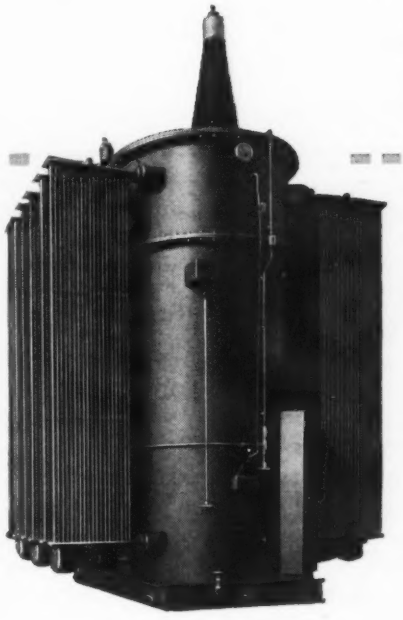
[a], [b] Alternates for respective indicated items

For Better Performance

specify

MOLONEY TRANSFORMERS

...less maintenance expense...longer life...
better performance proved by operating records!



POWER TRANSFORMERS

Research, with our 2,500,000 volt Surge Generator playing an important part, together with 50 years experience in the *exclusive* manufacture of transformers is responsible for the fine operating records users are experiencing with Moloney Power Transformers.

Modern design, workmen of long experience, highest grade material and adequate processing facilities are combined to produce these transformers.

DISTRIBUTION TRANSFORMERS

Moloney Conventional Distribution Transformers are widely used on utility distribution systems and in industrial lighting and power applications. Here too, Moloney's engineering and research have combined to make a superior product to fit your needs. Moloney Distribution Transformers are available in capacities from 1½ to 500 Kva, in voltages up to 66,000 volts.

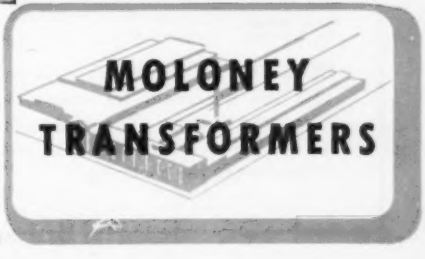
MOLONEY MAKES

- Power Transformers
- Unit Substations
- Conventional Distribution Transformers
- Completely Self-Protected (CSP) Transformers
- Load Center Transformers
- Askarel (Non-Inflammable Liquid) Cooled Transformers
- Air-Cooled (Class A and Class B Insulated) Transformers
- Constant Current Street Lighting Transformers
- Vault Type Transformers
- Submersible Type Transformers
- Industrial Transformers
- Network Transformers

TRANSFORMERS EXCLUSIVELY SINCE 1896

MOLONEY ELECTRIC COMPANY

SAINT LOUIS 20, MISSOURI



Impulse Cable Fault Locator

FLOYD W. BUCK
Engineering Dept
The United Illuminating Co
New Haven, Conn.

CABLE FAULTS can be found with a condenser discharge fault locator of the type used by the United Illuminating Co. The locator is not particularly useful on cable in underground ducts but has been highly efficient for aerial cable up to 2 miles minimum. Construction details are presented here. The principles involved are well known and the company does not claim credit for discovering them. An article on this method was published by the author in ELECTRICAL WORLD, May 25, 1946, page 111, "Condenser Pop Locates Aerial Cable Fault."

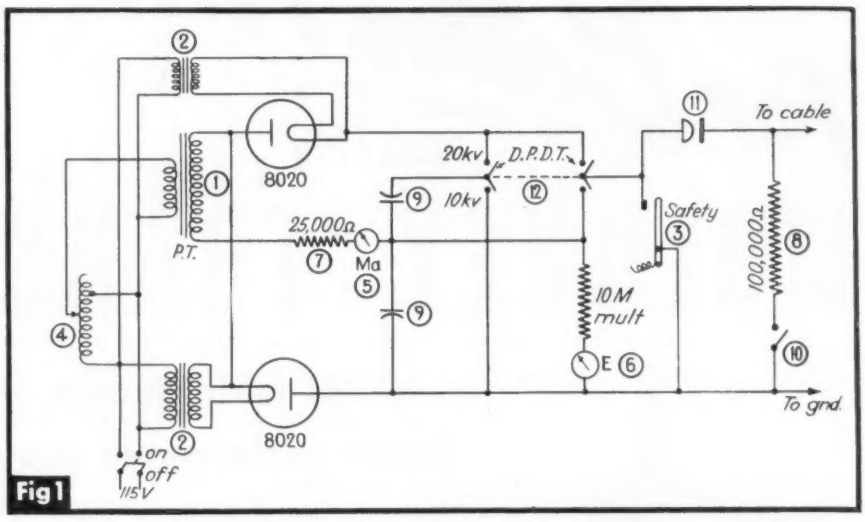


Fig 1

WIRING DIAGRAM of fault locator, 10-20 kv. Case measures 32 x 19 x 21 in. The following parts correspond to the numbers on the drawing: (1) Standard GE 6,900/115-v potential transformer; (2) UTC transformer, No. LS83 (insulation for 20 kv required); (3) safety discharge—hand close, spring return; (4) Superior Powerstat or General Radio Variac (possibly 1 kw); (5) milliammeter, 0-150 ma, d-c; (6) voltmeter, 0-10 kv, d-c; (7) resistor, 25,000 ohms—200 watts; (8) resistor, 100,000 ohms—50 watts; (9) condenser, 1 mf, 10 kv; (10) and (12) small knife switch with long blades; (11) sphere-gap with hemisphere about 1 1/2 in., opening to 1/2 in.

Construction Details

With very little equipment added to a simple rectifier and condenser set-up, much information can be obtained. Recourse to extra test apparatus is unnecessary. As shown in the circuit diagram (Fig 1), the set-up is basically a vacuum tube rectifier. This unit can charge 2 mf of capacitors to 10 kv, or by a single switch will operate as a voltage doubler to charge two 1-mf condensers to a total of 20 kv. The sphere gap isolates the rectifier and condensers until desired charge has accumulated. This depends on the gap opening. Then, by arc discharge across the gap, a steep-front wave is transmitted over the cable. This wave is of positive potential. It utilizes any corona effect at the fault to facilitate the arc there and consequent loud snap. Fault location is by ear. Radio pickup devices have been found to be almost useless, because of the amount of radiation occurring. The steep front is of sufficient frequency to provide copious radiation on both sides of the fault.

CLAMSHELL BUCKET for excavating vaults—Pacific Gas and Electric Co. uses this equipment for excavating underground transformer vaults in its San Francisco division. The three-wheel pneumatic KraneKar has an extendable boom. It has many other uses besides operating the ⅜-cu yd clamshell bucket shown here in the photograph.

Repeated Discharges

The 100,000-ohm resistor and switch provide a leakage to remove the discharge from the cable for faults burned clear. This permits repeated discharges, in many cases weakening the fault insulation enough to permit arcing. With this switch open, the meters can be used to obtain other information. By winding the gap closed and increasing the rectifier voltage with the Variac, the cable breakdown voltage can be determined. The ammeter and voltmeter can be used to determine leakage current at various voltages.

On Hand

To Help You—

with any problems you may have concerning insulated wires and cables are the Simplex sales staff, engineers, laboratory technicians, and manufacturing superintendents.

Their long experience with both standard and unusual specifications has given them a broad understanding of the problems associated with every type of wire and cable installation. The superior performance of Simplex products in the field attests to the value of their knowledge and skills.

Regardless of what your requirements may be, these men are available to you at all times for consultation. Their able assistance is yours for the asking and it places you under no obligation.

We urge you to include this service in all job planning so that yours may be a more prosperous New Year through the sound selection of electric wires and cables.

SIMPLEX WIRES & CABLES

SIMPLEX WIRE & CABLE CO., 79 SIDNEY ST., CAMBRIDGE 39, MASS.

Simple arithmetic then gives resistance to ground. The voltmeter reading must be doubled for the 20-kv connection. Also, the voltmeter current should be considered in all calculations, 1 ma at full scale, in this case.

Easily Transported

This unit is not intended for every fault. However it can be easily transported and set up and because of its comparatively low cost, it is a worthwhile adjunct to other equipment. It is important to remember that the set includes a lethal charge. The lid should never be opened or any connections touched without discharging after shutting the set off. The ground lead must always be grounded satisfactorily. The gap adjustment should be made with an insulated screw driver. Fig 2 and 3 show the exterior of the fault locator and the interior assembly of the equipment respectively. Note Lucite window.

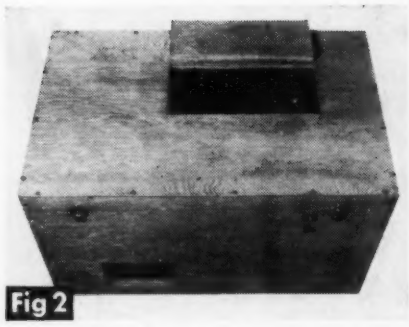


Fig 2

EXTERIOR VIEW of impulse fault cable locator. Window is ¼-in clear Lucite

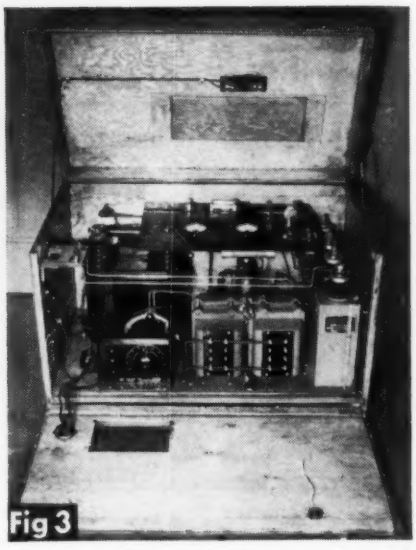


Fig 3

ASSEMBLY of equipment in fault locator. Note large wire in discharge circuit

• • •

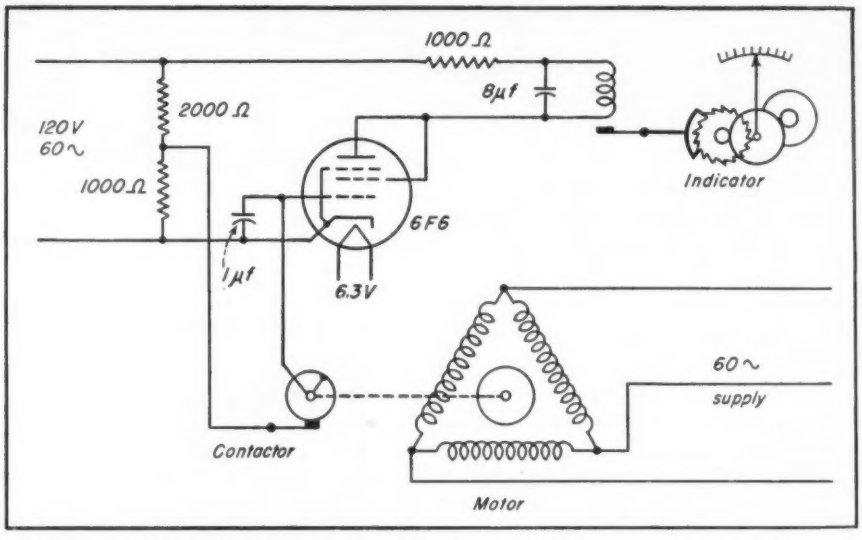
Electronic Slip Indicator Easily Built

MILTON M. FLANDERS

ORDINARY MEASURING METHODS are inadequate when an accurate determination of the slip of an induction motor is desired. Assuming a 4-pole, 60-cycle induction motor with a full load speed of 1,700 rpm, an error of one-half of 1 percent in the measurement of the actual speed would result in an error of 8½ percent in terms of slip. If the slip is measured with the same accuracy as the actual speed, the slip error in this case would be reduced to one-half of 1 percent; the measurement would be correct to within one-half of one revolution.

Many methods have been employed for the direct measurement of slip. The measuring device should be compact, accurate, and impose only a small load on the motor under test. It is also desirable that the indications be recorded in some easily interpreted form. This electronic indicator meets these requirements and can be made easily from inexpensive materials. The accompanying sketch shows the circuits employed.

The contactor, which simply provides an electrical contact with each revolution of the motor shaft, is incorporated in a hand instrument that can be held in any shaft center or permanently mounted on the motor shaft when repeated measurements are to be made on the same motor.

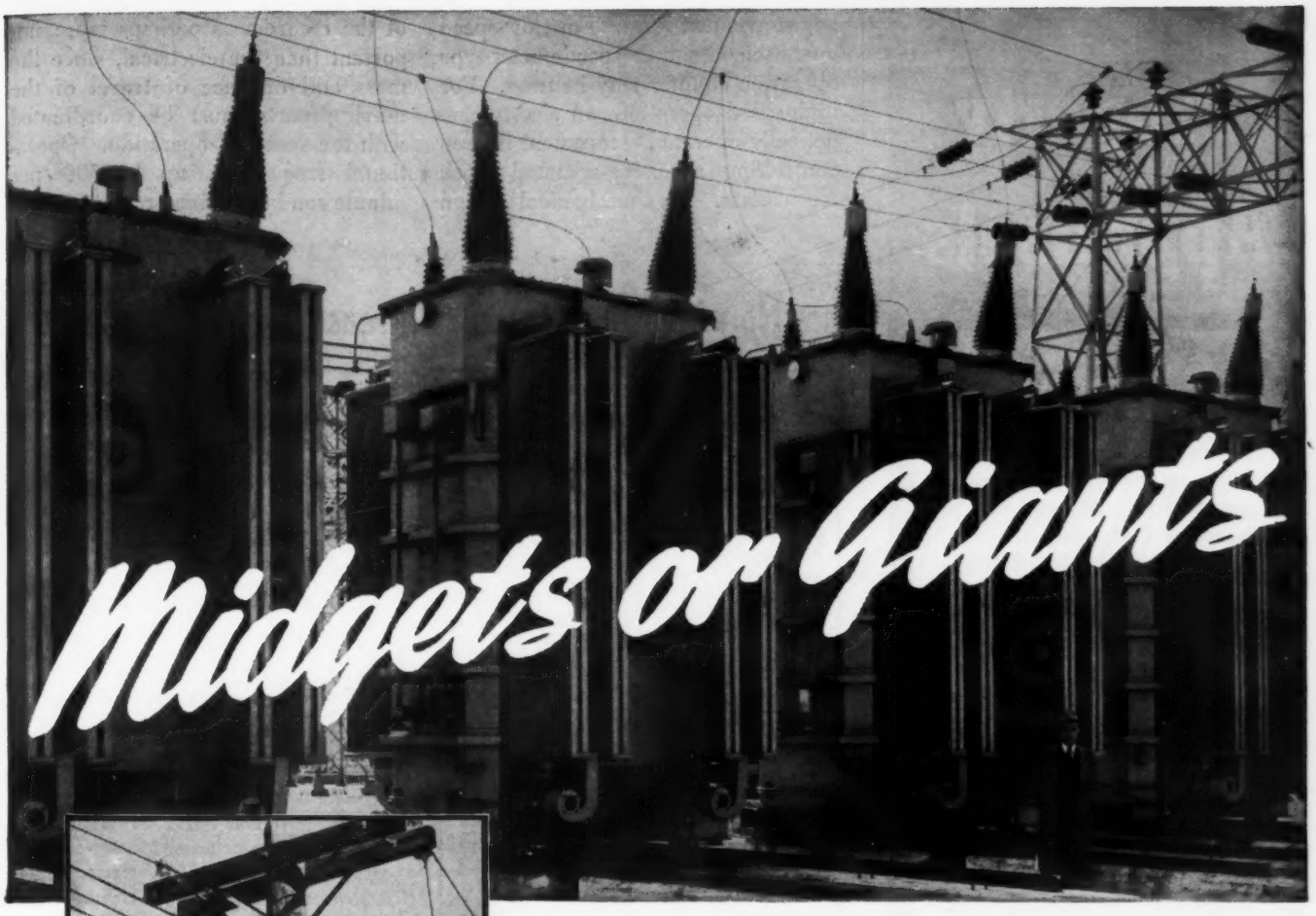


CIRCUIT LAYOUT of electronic slip indicator. A 6F6 tube, used as a triode, was selected because of its characteristics and availability

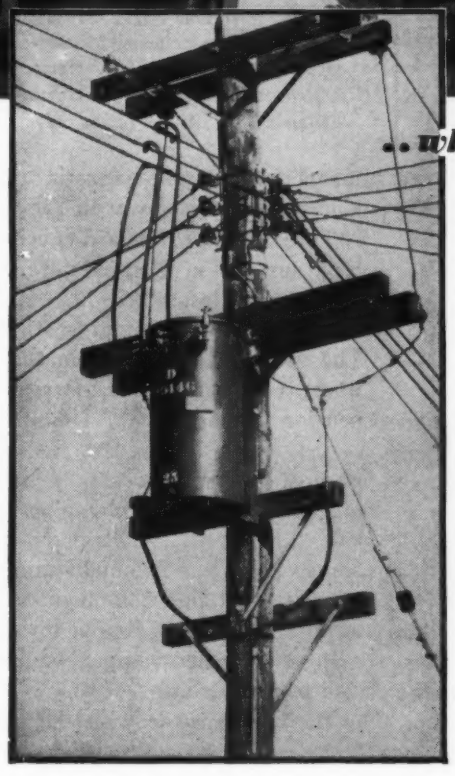
As the rotor slips behind the synchronous speed, the control grid of the tube becomes alternately negative and positive with each *cycle* slip. A suitable operation indicator is connected in the plate circuit. This records each time the circuit becomes conducting. For a two-pole motor, each operation indicates one revolution slip. For a four-pole motor, each operation of the indicator corresponds to one-half revolution slip; and with a six-pole motor, each indication represents one-third revolution slip. Thus the percent error in measurement is the same for all applications regardless of the number of poles or the rated rpm of the motor.

A 6F6 tube, used as a triode, was selected because of its characteristics and availability. But other types can be used equally well. The capacitance of the grid condenser is somewhat critical for best results and obviously cannot be of the electrolytic type.

The recorder mechanism can take



Midgets or Giants



..whether Your Power Problem is Large or Small

a Wagner Transformer Can Solve It!

MIDGETS on poles—Giants in Power Plants—Wagner Transformers are giving account of themselves by maintaining continuity of service. They keep the lights burning in homes . . . They keep the wheels of industry turning with unfailing dependability that has made Wagner Transformers world famous.

Whether your power problem is large or small—Wagner can furnish the transformer that will give you the solution. Users of Wagner transformers also profit by our quick, convenient, nation-wide service facilities.

Fifty years of experience and knowledge, gained in furnishing transformers of all sizes and types, stands behind every Wagner product. Twenty-nine branch offices manned by trained field engineers are ready to serve you.

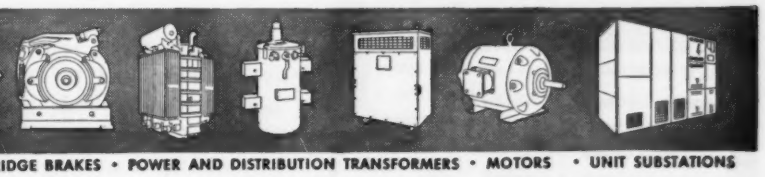
Write for Bulletins TU-180 and TU-181

Address Wagner Electric Corporation, 6456 Plymouth Avenue, St. Louis 14, Mo. for these valuable Bulletins on the complete line of Wagner Transformers.

T47-4

Consult Wagner Engineers on All Transformer Problems.

Wagner Electric Corporation EST. WE 1891



BRIDGE BRAKES • POWER AND DISTRIBUTION TRANSFORMERS • MOTORS • UNIT SUBSTATIONS

ELECTRICAL AND AUTOMOTIVE PRODUCTS

Property Appraisals

HERE'S an appraisal available for *any* situation—to meet the needs of buyer or seller. In one convenient package you can get any of the following features:

Inventory of physical properties; inventory priced at original, historical or current costs; studies of depreciation and reserve requirements.

Studies of intangible values; business value based on earnings and market value of income, operating costs, price and economic trends.

Assistance in mergers, consolidations, condemnation and severance damage matters; allocation of properties, operating costs and revenues for inter-company purposes.

EBASCO specialists include experienced engineers, accountants, financial, rate and other experts.

A complete outline of EBASCO'S individualized service to top-management is contained in the brochure "The Inside Story of Outside Help"—a guide to successful outside help in your business and industry. Your copy on request.

EBASCO SERVICES INCORPORATED

TWO RECTOR STREET, NEW YORK 6, N. Y.

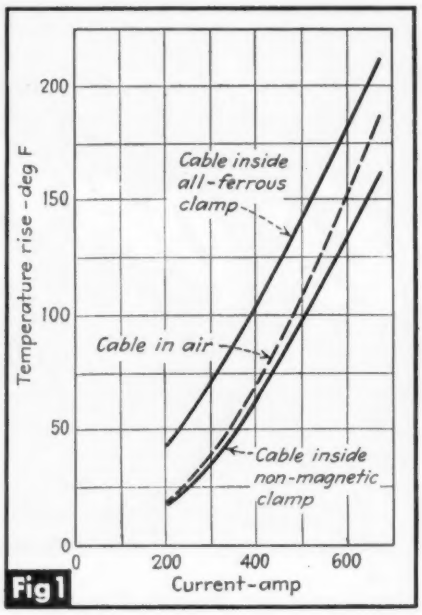
Engineers — Constructors — Business Consultants

SERVICES OFFERED—Accounting • Appraisal • Budget • Consulting Engineering • Design & Construction • Financial • Industrial Relations • Inspection & Expediting • Insurance • Purchasing • Rate & Pricing • Research • Sales & Marketing • Tax • Traffic

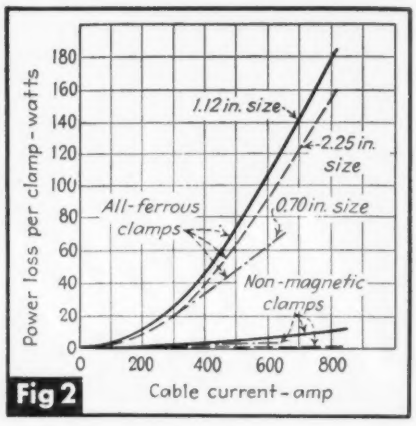
any convenient form. For slow-speed operation, a simple speedometer-type operation counter may be used. For high-speed operation, an electromagnetically operated escapement is used controlling a spring-actuated clock mechanism. The mechanical design of the recorder is perhaps more important than the electrical, since the mass and distance of travel of the moving parts must be coordinated with the speed of operation. Operational frequencies up to 500 per minute can be obtained readily.

• • •

Non-Magnetic Clamps Increase Power Savings



TEMPERATURE RISE as a function of cable current for 1-in. suspension clamps with 336,400-cir mil ACSR



POWER LOSS as a function of cable current for three sizes of suspension clamps: 0.70-in. clamp, 350,000-cir mil copper conductor; 1.12-in. clamp, 795,000-cir mil ACSR; 2.25-in. clamp, 795,000-cir mil ACSR with armor rods

J. M. SHEADEL
Development Engineer
Ohio Brass Co
Mansfield, Ohio

CLAMP LOSSES are only a small part of over-all transmission loss. But their saving is often economically justified, and can be of considerable value.

Conductor heating and its associated annealing effect are part of this problem. Maximum temperature frequently occurs at splices or at line hardware. For conductors and splices, this temperature rise is caused by the I^2R loss. In suspension clamps, however, the temperature rise is a result of hysteresis and eddy current loss within the ferrous parts.

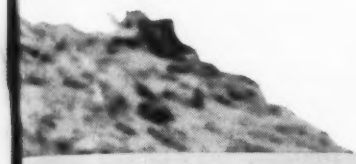
When non-magnetic material is used for the suspension clamp body and clamping piece, tests show that the temperature rise within the clamp is less than that in cable freely exposed to air. This is due to the increased radiation of the larger mass of metal in the clamp. Temperature rise-cable current curves for 1-in. magnetic and non-magnetic suspension clamps are shown in Fig 1.

Three sizes of standard enveloping-type suspension clamps were tested for power loss: 0.70-in., 1.12-in., and 2.25-in., maximum seat width. The variations included in the tests were: (1) Standard all-ferrous suspension clamps with U-bolts and socket eyes; (2) standard suspension clamps of similar design with non-magnetic body and clamping piece, and with ferrous U-bolts, nuts, rivets, and socket eyes. Although aluminum was used as the non-magnetic material in these tests, similar low losses will occur when copper or bronze clamps are used.

Tests were made with the clamps mounted on a cable which formed the secondary of a high-current transformer. Usually four clamps were placed on a loop about 6 ft in circumference. Sixty-cycle current in the secondary was controlled by a Variac on the primary of the transformer. A given test current was held constant until the temperature equilibrium was reached.

Power loss was measured by a wattmeter in the primary circuit. By test

This actual photograph of an out-of-service pole butt dramatically pictures only one type of wood destruction that can be prevented with formulations of Santophen 20 —Monsanto's pentachlorophenol, technical.



Longer life with Santophen 20 because of wide range of fungi controlled by pentachlorophenol

Toxicity of Pentachlorophenol to fungi as determined at Monsanto Chemical Company by the Malt-Agar-Petri-Plate Test Method		Inhibiting Concentration	Killing Concentration
Organism	Type	(% penta-chlorophenol)	(% penta-chlorophenol)
Ceratostomella pilifera	Wood stainer	0.006	0.006
Hormonema dematioides	Wood stainer	0.006	0.006
Hormodendrum cladosporioides	Wood stainer	0.006	0.05
Hormiscium gelatinosum	Wood stainer	0.02	0.02
Alternaria tenius	Wood stainer	0.02	0.02
Polystictus versicolor	Wood rotter	0.008	0.01
Polystictus hirsutus	Wood rotter	0.008	0.02
Coniophora cerebella	Wood rotter	0.002	0.002
Fomes roseus	Wood rotter	0.006	0.006
Fomes annosus (F.P.L. 517)	Wood rotter	0.002	0.006
Lentinus lepideus	Wood rotter	0.002	0.004
Poria incrassata	Wood rotter	0.002	0.002
Trametes serialis	Wood rotter	0.001	0.002
Lenzites saepiaria	Wood rotter	0.002	0.006
Lenzites trabea	Wood rotter	0.002	0.004
Merulius domesticus	Wood rotter	0.001	0.001
U-10 (From Bell Telephone Lab.)	Wood rotter	0.002	0.002
Chaetomium globosum	Textile rotter	0.008	0.01
Tricophyton rosaceum	Animal pathogen	0.004	0.006
Tricophyton interdigitale	Animal pathogen	0.006	0.008
Epidermophyton inguinale	Animal pathogen	0.004	0.004
Fusarium vasinfectum	Plant pathogen	0.01	0.02
Aspergillus niger	General	0.006	More than 0.1
Penicillium digitatum	General	0.006	0.008
Alternaria radicina	General	0.006	0.006
Rhizopus nigricans	General	0.004	0.006

Longer life with Santophen 20 because of vapor pressure of pentachlorophenol

Temp., °C.	m. m. of Mercury	Temp., °C.	m. m. of Mercury
0	0.000010	110	0.24
20	0.00011	120	0.45
50	0.0023	130	0.82
75	0.019	140	1.45
100	0.12		

(The vapor pressures of Pentachlorophenol shown in the table were determined on pure material by the static method and the data plotted on a curve.)

Longer life with Santophen 20 because of potency of pentachlorophenol

Preservative	Killing Concentration (% by weight)	Reported by
PENTACHLOROPHENOL	0.002	Bateman and Baechler
Mercuric chloride	0.005 to 0.006	Bateman and Baechler
2-Chlororthophenylphenol	0.009 to 0.01	Hatfield
Betanaphthol	0.015	Bateman and Baechler
Sodium dichromate	0.03	Bateman and Baechler
Sodium chromate	0.034	Bateman and Baechler
Coal-tar creosote, sample 8387 (sp. gr. 1.040)	0.05 to 0.1	Schmitz
Zinc-meta-arsenite	0.10	Curtin and Thordarson
Borax (sodium tetraborate)	0.13	Bateman and Baechler
50:50 creosote-coal-tar solution	0.2 to 0.6 (according to creosote used)	Schmitz
Boric acid	0.25	Bateman and Baechler
Sodium fluoride	0.25	Richards
Wood-tar creosote	0.25 to 0.05	Hatfield
Zinc chloride	0.35	Richards
50:50 creosote-petroleum solution	0.5 to 3.0 (depending on oils used)	Schmitz
Coal tar, sample 8400 (sp. gr. 1.166)	0.9 to 1.0	Schmitz
Water-gas-tar creosote (Sample 2233)	6.5 to 0.65	Fleming and Humphrey
Petroleum	Above 10.0	Schmitz

Killing concentration of various materials to the fungus "Madison No. 517" (formerly called *Fomes annosus*).

(Reproduced in part by permission from WOOD PRESERVATION by Hunt and Garratt, Copyrighted, 1938, by the McGraw-Hill Book Company, Inc.)

Longer life with Santophen 20 because of low water solubility of pentachlorophenol

Temperature degrees, C.	Solubility gram/100 grams water
0	0.0005
27	0.0018
50	0.0035
62	0.0058
70	0.0085

(Determined in Monsanto laboratories.)

SERVING INDUSTRY...
WHICH SERVES MANKIND

MONSANTO
CHEMICALS AND PLASTICS

MONSANTO CHEMICAL COMPANY EW-12
Organic Chemicals Division
1700 South Second Street, St. Louis 4, Missouri

Please send further information on Santophen 20 for treating .....

.....

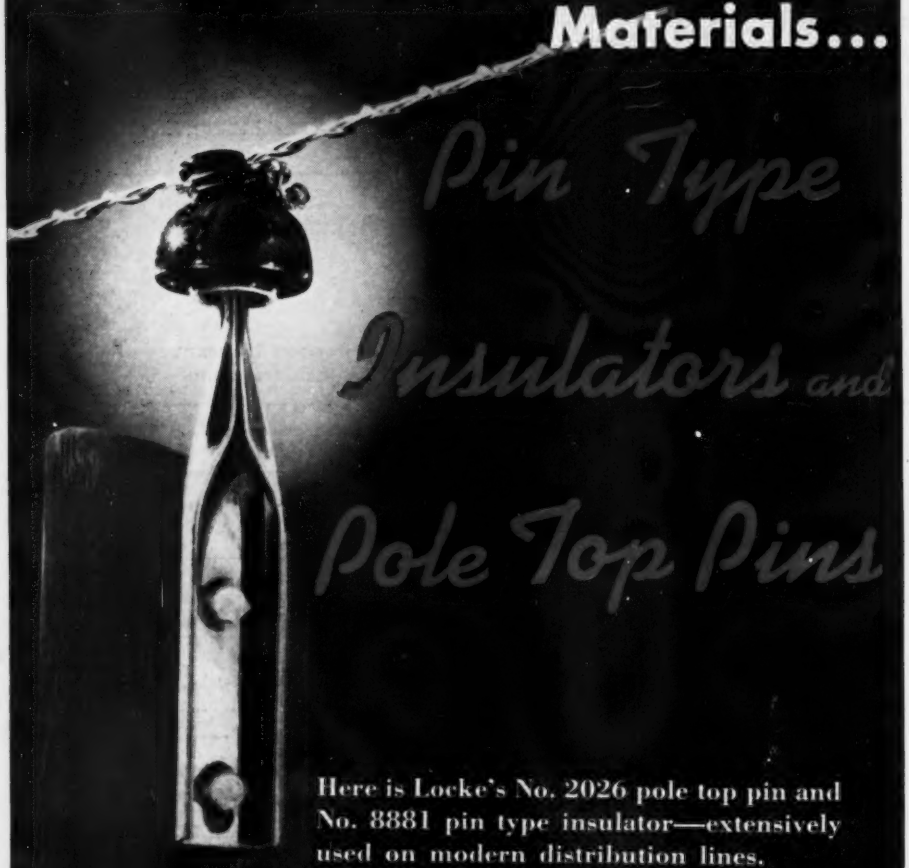
Name.....

Firm.....

Address.....

City.....State.....

Look to Locke for Distribution Materials...



Here is Locke's No. 2026 pole top pin and No. 8881 pin type insulator—extensively used on modern distribution lines.

Accurately formed pin threads allow the insulator to seat properly and develop its full strength. The lead alloy cob is positively bonded to the steel pin—no loosening from vibration. And with *Permazinc*—Locke's *Quality Controlled* double hot-dip galvanizing—for added years of dependable service.

The insulator is of wet process porcelain for best electrical characteristics, with *Compression Glaze* — originated by Locke — for highest mechanical strength. Pins and insulators are designed together and made together to work together.

Complete lines of distribution materials are maintained in six Locke regional warehouses and in most distributors' stocks. Get in touch with your Locke representative or distributor.

Depend on Locke for ***Quality Controlled*** distribution materials—pole line hardware and insulators. *One* order covers *both*.

Locke **POLE LINE HARDWARE** *and* **INSULATORS**

LOCKE INSULATOR CORPORATION • BALTIMORE 3, MD.

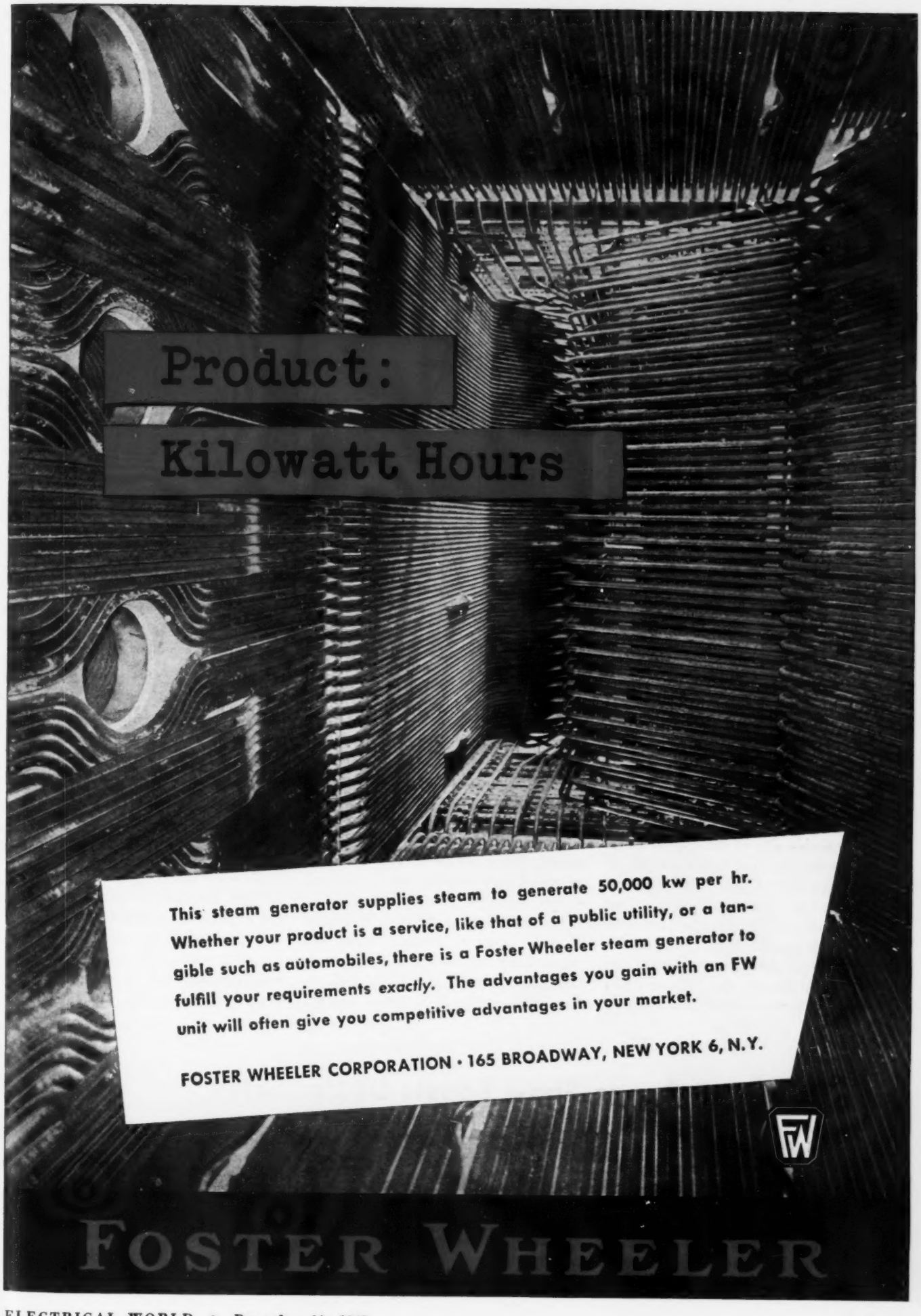
and calculation, losses in the primary winding, transformer iron, and secondary cable were determined. The remainder was the loss in the suspension clamps. For the test circuit, this was about 60 percent of the total power input measured at the primary.

These power loss measurements are shown in Fig 2 as a function of the cable current. As a check of the method, the power loss in the 0.70-in., all-ferrous clamp with U-bolts was determined with a calorimeter at cable currents of 193 amp, 384 amp and 575 amp. The wattmeter method was verified within 2 percent. Tests were also made on a sample quantity of 20 all-ferrous suspension clamps of the 0.70-in. size. Here, the average loss per clamp at a cable current of 384 amp was 33 watts as compared with an average of 31 watts on a quantity of four. The curves indicate that clamps with a non-magnetic body and keeper piece will have an appreciably smaller power loss than the all-ferrous clamps. The use of armor rods over the cable caused a slight reduction in power loss in ferrous suspension clamps, even though a larger clamp was required.

Power loss in suspension clamps appears to be a function of the following factors: (1) the magnetic properties of the material; (2) conductor current; (3) bolting arrangement; and (4) size of clamp.

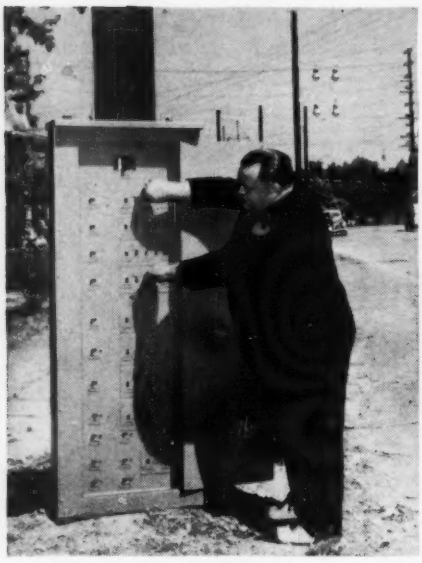
Maintenance of good electrical contact between conductor and clamps is favored by the use of similar materials for these parts. Galvanic corrosion is eliminated or greatly reduced. When power arcs terminate on line hardware, strand burning is influenced by the presence of accumulated corrosion products between clamp seat and conductor, inadequate tightening of clamping bolts, and high-fault currents. Similar material in both clamp and conductor reduces the possibility of conductor damage within the clamp.

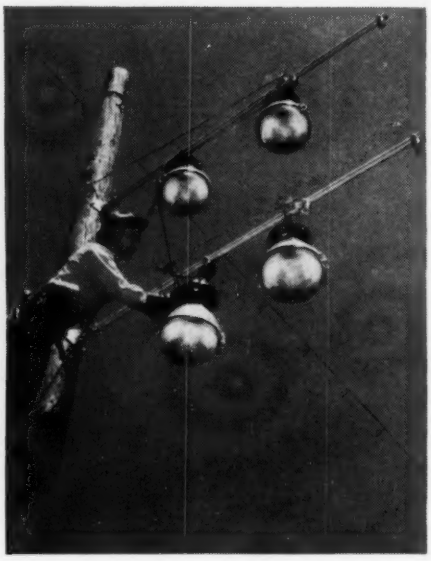
The watt loss shown in these tests for all-ferrous clamps may not be a very significant part of the total power loss in the conductor. But for heavily loaded circuits, the savings resulting from the use of non-magnetic clamps will, within a few years, equal the cost of these clamps. Such savings may be estimated by applying local generating cost and load factors to the watt loss values of the curves.


Product:
Kilowatt Hours
This steam generator supplies steam to generate 50,000 kw per hr. Whether your product is a service, like that of a public utility, or a tangible such as automobiles, there is a Foster Wheeler steam generator to fulfill your requirements exactly. The advantages you gain with an FW unit will often give you competitive advantages in your market.
FOSTER WHEELER CORPORATION • 165 BROADWAY, NEW YORK 6, N.Y.
FW
OF
FOSTER WHEELER

LOAD BUILDING

Selling Street Lighting by Demonstration





LATEST PRACTICE in street and highway lighting will be demonstrated at this outdoor laboratory by Portland General Electric Co. Small-town officials can benefit by seeing proposed solutions to their particular problems. Type of luminaire, mounting height, spacing and other determinants can all be set up on central control board

AN EFFECTIVE MEANS of visually demonstrating the difference between adequate and inadequate solutions to a given community street lighting problem has been found by Portland General Electric Co, Portland, Ore. At a suitable site in the city of Portland, poles carrying various types of luminaires have been erected. A central control board allows various types and combinations of units to be demonstrated. Most of the equipment was purchased in kit form from the General Electric Co. Major items include: Radial wave fixtures for 1,000-, 2,500- and 6,000-lumen lamps; open and enclosed suburban units; refractor units for 6,000- and 10,000-lumen lamps; upright ornamental luminaires; and deflector types for both incandescent and mercury vapor luminaires. Up to 30 practical combinations and arrangements of various units can be demonstrated from the control board.

Installation is at the intersection of a main arterial leading from the edge of the city, and a side street entering the arterial at a slight incline. The incline affords a better over-all view of the various lighting combinations. The control board, installed at the intersection, is laid out with a sub-main breaker and toggle switches. These control unit on each pole.

Most cities served by this utility are not sufficiently populous to support a public works department competent to pass on street lighting recommendations. Because of their inability to see a planned installation in advance of approval, tax-conscious officials may allow financial considerations to compromise the adequacy of a planned lighting job.

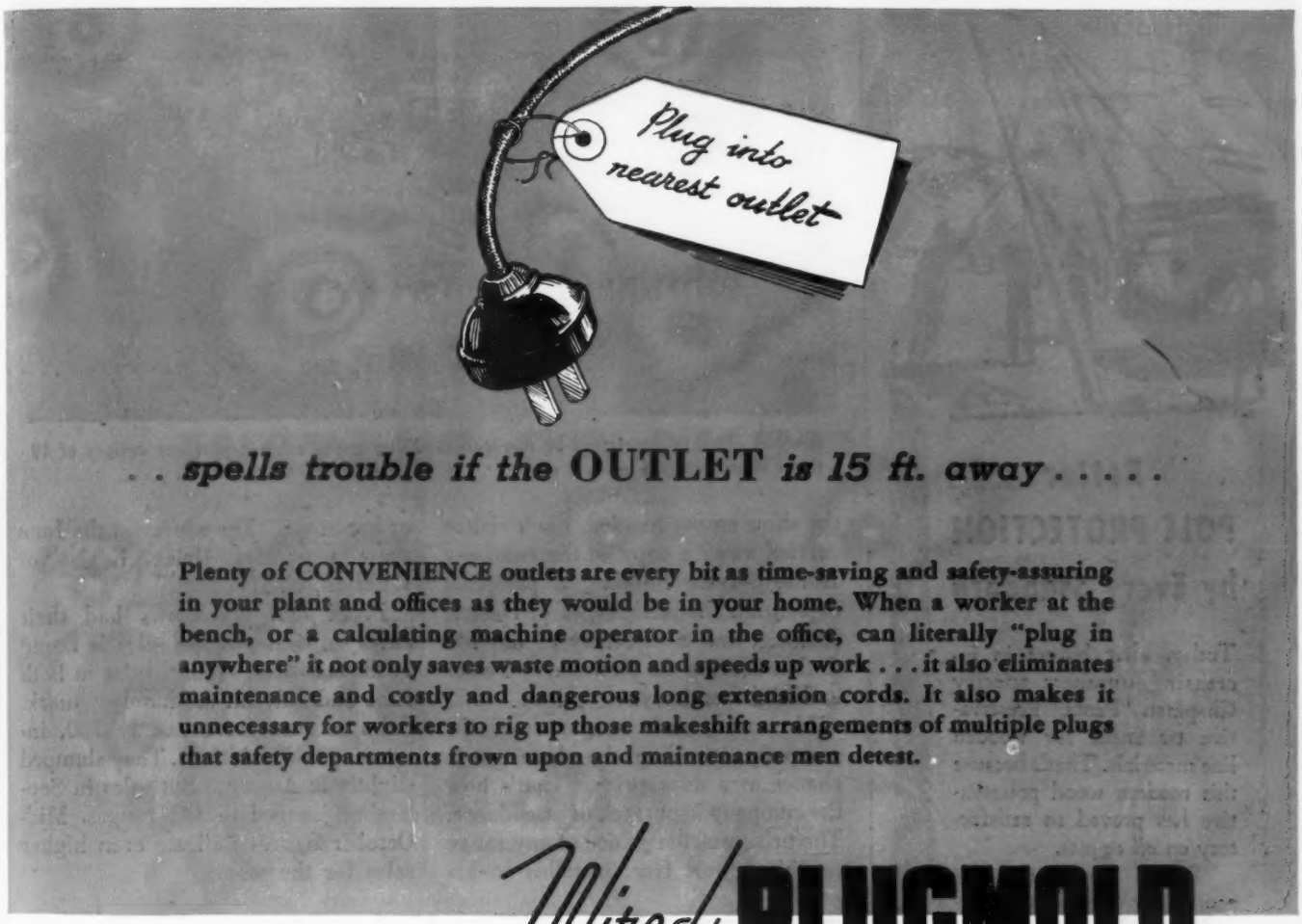
• • •

Range Show Boosts Dealer Sales

DEALER SALES of electric ranges were boosted by two one-week electric range shows put on this summer —one in June, the other in September —by the New Jersey Power and Light Co. This non-merchandising company wanted to show its customers the variety of choice they have among ranges of different makes and types.

In the earlier show, 19 range makers each exhibited two models. In September, 19 manufacturers showed three models each. With this display, the company hoped to smother the widely held impression that only four or five makes of ranges exist.

Very few of the 1,000 people who came to the June show—or the 2,000 who viewed the September one for that matter—just "dropped in." Almost all came to examine and compare, to weigh and consider, R. H. Rehrer, company residential sales manager, reports. Nor did they leave



. . . ***spells trouble if the* OUTLET *is 15 ft. away*** . . . . .

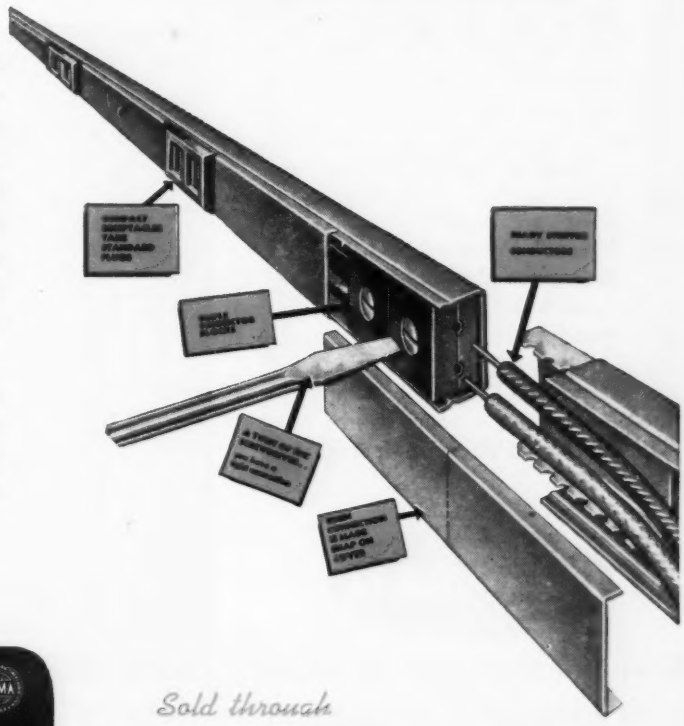
Plenty of CONVENIENCE outlets are every bit as time-saving and safety-assuring in your plant and offices as they would be in your home. When a worker at the bench, or a calculating machine operator in the office, can literally "plug in anywhere" it not only saves waste motion and speeds up work . . . it also eliminates maintenance and costly and dangerous long extension cords. It also makes it unnecessary for workers to rig up those makeshift arrangements of multiple plugs that safety departments frown upon and maintenance men detest.

The New Answer is . . . *Wired* PLUGMOLD

With the announcement by Wiremold of NEW WIRED PLUGMOLD, the way to truly adequate convenience outlet wiring in your plant or offices has been made easy . . . and inexpensive. Factory-prewired, ready-to-install by your maintenance man or contractor, WIRED PLUGMOLD immediately gives you "all the outlets needed exactly where they're needed" on 110 V. 2-wire circuits. Where larger capacity or 3-wire circuits are required, larger unwired No. 2100 PLUGMOLD does the same efficient job.

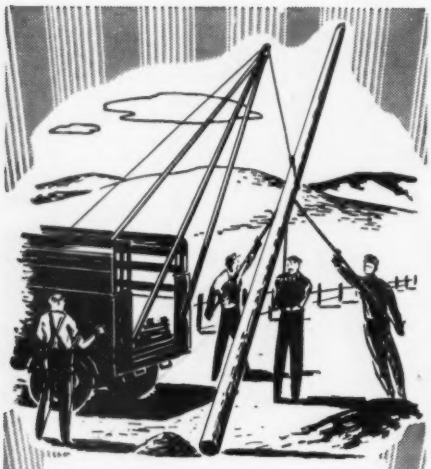
This is an Adequate Wiring program you can begin now with material available NOW. Write us today for a copy of Bulletin 533 . . . Complete how-to-use information about WIRED PLUGMOLD, installation details.

THE WIREMOLD COMPANY
HARTFORD 10, CONNECTICUT



Know your WIREMOLD
NEMA
. . . . MORE THAN ADEQUATE WIRING

Sold through
ELECTRICAL WHOLESALERS
Installed by
ELECTRICAL CONTRACTORS
Everywhere



Better
POLE PROTECTION
by Every Standard

Today, alert buyers in increasing numbers specify Chapman "Penta" Preservative treatment for wooden line materials. That's because this modern wood preservative has proved so satisfactory on *all* counts.

"Penta" Preservative, by actual test, provides unsurpassed protection against rot and insect damage.

Wood treated with "Penta" Preservative is practically odorless and clean to handle. That makes it favored by installation and maintenance crews.

Finally, regular treating plant methods and equipment are used to apply "Penta" Preservative. Most progressive plants use it now — all can get it for you quickly.

The complete, interesting story on Chapman "Penta" Preservative is yours for the asking. Write for details today.

CHAPMAN

CHAPMAN CHEMICAL COMPANY
Suite 542
333 N. Michigan Ave., Chicago 1, Ill.

"Penta" Preservative contains
Pentachlorphenol, a product of
The Dow Chemical Company

RANGE SHOW conducted by non-merchandising utility exhibits post-war designs of 19 range manufacturers

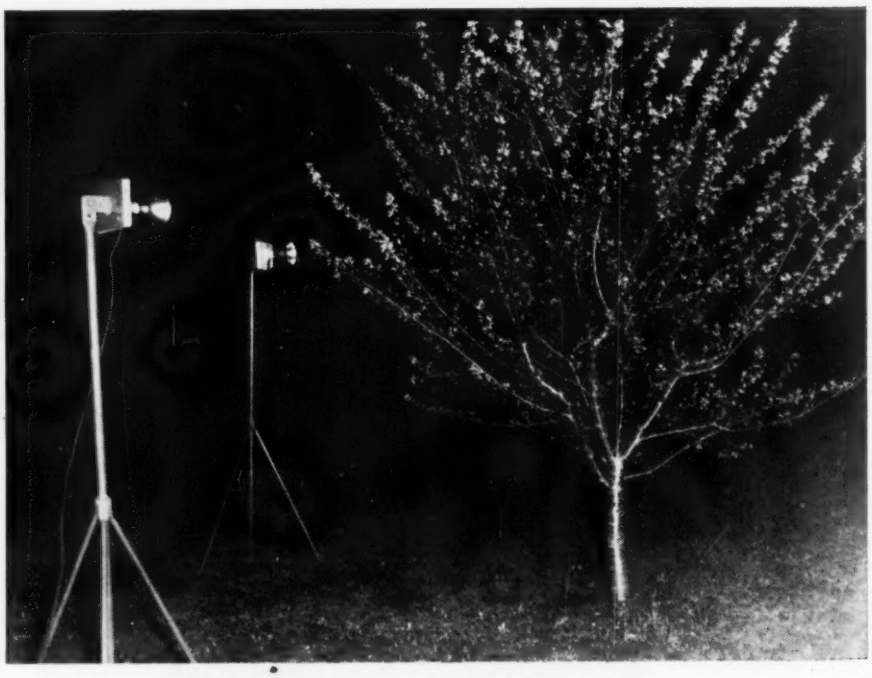
the show empty handed. Each visitor carried away a copy of the company Home Service Bulletin, a pamphlet explaining the advantages of electric cooking, and a directory of the 160 dealers serving the New Jersey Power and Light territory.

Moreover, each customer of the company attending the show got a chance at a door prize. That's how the company kept track of attendance. The prize was the choice of any range exhibited, cost free, installed in his or her home. The winner at the June show was Mrs Helen Eagles of Wharton, N. J.

Proof that the shows had their effect on dealer range sales is found in the statistics. Range sales in both June and July hit the hundred mark. Sales in June were exactly 100, increasing to 119 in July. They slumped slightly in August. But sales in September jumped to 143 ranges. Mid-October figures indicate even higher sales for the month.

• • •

Infrared Protects Fruit Buds from Frost



SIMPLE PIPE STANDS support thermostatically controlled R-40's

INFRARED heat lamps are used to protect delicate fruit tree buds from frost in the orchard of Elmer C. Siegreen, Saginaw, Mich. This Consumers Power customer for the past several years had been having trouble with frost just as buds were coming out. This reduced his crop. Then he

Save Time AND *Money*!

INSTANT CLEANING!
INSTANT STARTING!
INSTANT RELAMPING!

with

Guth

FLOATING-HINGE ARISTOLITES

and Quickliter Ballasts

The amazing new GUTH Floating-Hinge Aristolite makes cleaning a pleasure instead of a chore! An easy, quick nudge on the glass panels (right from the floor, with the simple GUTH Gripper-Duster Tool!) and the panels literally "float" free—hanging at the side, out of the workman's way! No time-wasting, dangerous maintenance tricks. It's all as simple as ABC.

GUTH Floating-Hinge Aristolites give open fixture cleanliness with glass panel diffusion and beauty—plus tremendous savings in time and work.

Add to these advantages the Quickliter Ballast. It gives light at the flick of the switch—starterless operation—simplified relamping! The combination makes one of the best looking, best operating—most economical Fixtures ever made!

Write today for full details.

ARISTOLITE
Trade Mark Reg., U. S. & CAN. PATS. PEND.

OUR *45th* ANNIVERSARY YEAR

THE EDWIN F. GUTH CO.
ST. LOUIS

Guth

Leaders in Lighting Since 1902

HAVE YOU A CORROSION PROBLEM ?

THE NEW HARPER COMPUTER WILL SHOW THE PROPER ALLOY BOLT TO USE

Free on request to executives, engineers and others interested in fastenings.

The new Harper Computer of Corrosion Resistance operates simply, like a slide rule. 142 corrosive situations commonly encountered in industry are analyzed with respect to 13 non-ferrous and stainless steel alloys. It is an indispensable working tool for anyone concerned with selecting alloy fastenings to meet various corrosive conditions. Write for one now.

THE H. M. HARPER COMPANY
2611 Fletcher St., Chicago 18, Ill.
Offices in principal cities

HARPER
Everlasting Fastenings
Chicago

fastenings of
NON-FERROUS AND STAINLESS STEEL ALLOYS

discovered that infrared heat lamps could be used to protect the trees. He made six portable pipe stands; at the tops of these the lamps were adjustably mounted. A thermostat switch closes the circuit when the temperature drops near freezing. Mr Siegreen has found that two R-40 250-w lamps per tree are ample for frost protection for young trees. However, in the case of larger trees, three or more lamps may be required.

•

Lighting an Essential Merchandising Tool

A SIGNIFICANT BYPRODUCT of a recent electric shop survey in Boston was a study of the relationship between lighting and sales atmospheres. The survey was conducted incognito under the auspices of the Electric Institute of Boston, Inc. Of 105 stores visited, only six qualified as excellent from the lighting standpoint. Seventy-five were classified as adequate, and 24 as inadequate. In window displays, 83 were characterized as well lighted and 22 as below par.

Rating Factors

The six stores rated as excellent had these following four factors in their favor:

1. Strong and brilliant lighting, notable around the entrance.

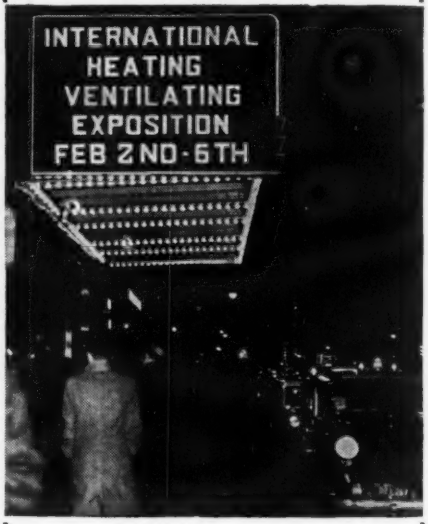
2. A sense of brightness on entering the store. White or pale ceilings and upper walls to encourage the eye to sweep the whole interior.

3. Brilliant areas or details at far ends of aisles. These "color magnets" broke up monotony and invited greater circulation of visitors.

4. Deeper tones behind merchandise. These were properly balanced in hue and value to give high visibility to products on display.

The over-all average rating of stores having well-lighted windows was 69 percent in merchandising efficiency as against but 26 percent for those considered as insufficiently illuminated. By the same token, stores having excellent interior lighting rated at 86 percent in merchandising efficiency; those having adequate lighting rated 71 percent in sales efficiency; and those inadequately lighted hit only 35 percent effectiveness.

Portals to Progress

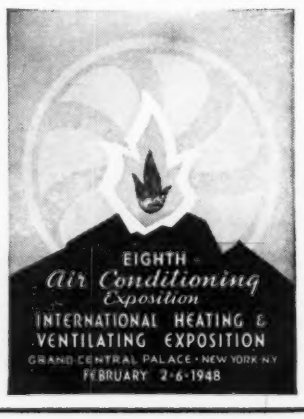


. . . in Air Conditioning -Heating-Ventilating

Come to Grand Central Palace, New York City, February 2 to 6!

Assembled here you'll see over 350 arresting displays and demonstrations of the newest and best ways to heat, ventilate and condition air for all types of commercial and public buildings, industrial plants, and homes. Here in less than a week's time you can study and compare the relative merits of everything from complete units to maintenance supplies—in the light of your customers' needs . . . discuss your problems and plans with technical attendants at the booths—men on hand expressly to help you with your problems, tell you what you want to know to keep abreast of the trends and practices in these active fields.
The wealth of worthwhile stimulating ideas, information and contacts at this exposition will be invaluable in building new business for you. Plan now to attend —have your associates come, too. Mark the date.

Under Auspices of American Society of Heating & Ventilating Engineers.



Combined...

TO GIVE YOU *DOUBLE* UNDERGROUND PROTECTION

Developed primarily for direct earth burial or duct service, RoMarine-RoPrene combines a superior moisture resistant insulation with the well known durability of a Neoprene jacket. Here is a *double* protection. You get an underground cable of high electrical stability in the presence of moisture, with long life, as well as resistance to oils, soil acids and alkalies, and other corrosive elements. Unaffected by sunlight and oxidation, it possesses superior weathering properties . . . If it's going underground, remember RoMarine for high quality, low water absorption, insulation . . . and RoPrene for rugged, long life sheath protection. Combined, they assure a long service life of dependable operation.

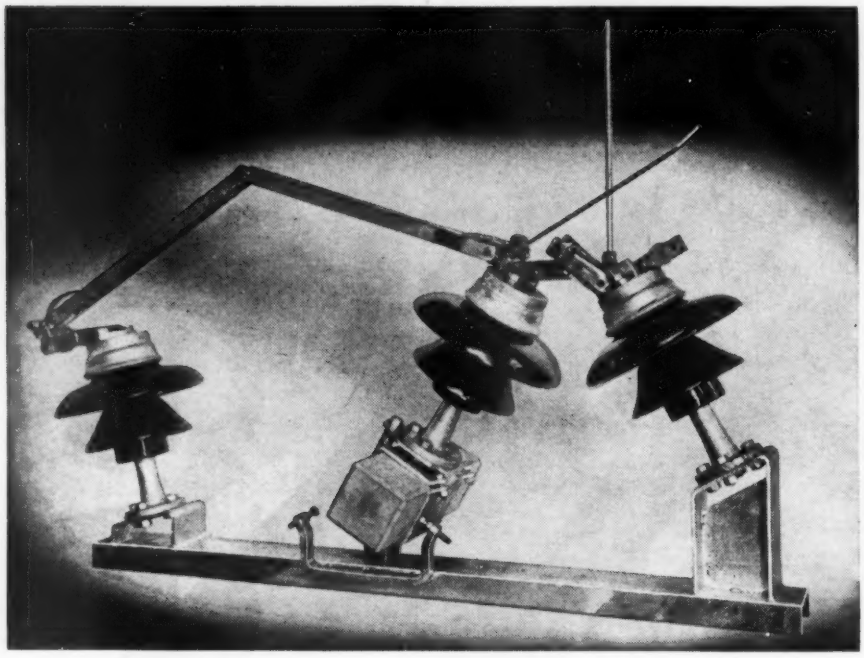
RoMarine-RoPrene is available in a range of sizes in both single and multiple conductors.

FROM BAR TO FINISHED WIRE

ROME CABLE CORPORATION

ROME • NEW YORK

NEW EQUIPMENT

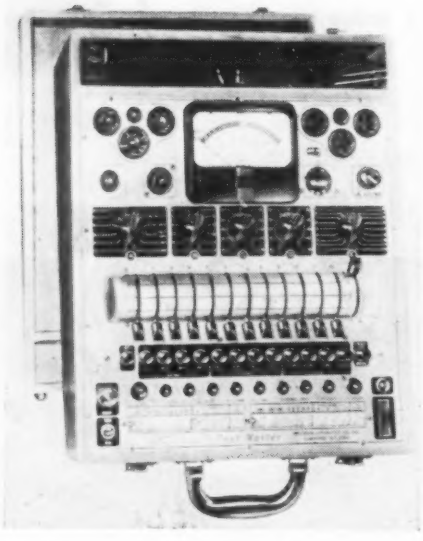


Air-Break Switch

A NEW LINE of air-break switches intended primarily for rural service is announced by Hi-Voltage Equipment Co, 4000 East 116th St, Cleveland 5, Ohio. Designated type A-R, the switches are rated 200 amp and are manufactured for four voltages—7,500, 15,000, 23,000 and 34,500.

Among the features are: (1) Switch base and insulator supports are rolled steel sections welded into a rigid unit; (2) all four models are built on 3-in. bolt circle NEMA standard insulators; (3) contacts are stated to be self-aligning, line type enclosed by a steel hood that also acts as a guide for the switch blade; (4) a pantagraph provides flexible connection from the tilting insulator, and ensures proper ground clearance; (5) switch is made as nearly lightning-proof as possible by use of wood interphase bars and a 6-ft wood insulating section in the operating mechanism.

•



Tube Tester

PERFORMANCE CAPABILITIES of electronic tubes can be determined by the new Series 10-20 Electronamic Test Master announced by Precision Apparatus Co, Inc, 92-27 Horace Harding Blvd. Elmhurst. L. I., N. Y. The instrument includes the tube performance test circuit plus a pushbutton operated a-c and d-c set tester.

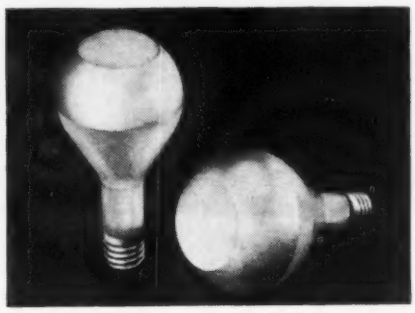
The tube test circuit features direct facilities to accommodate up to twelve elements and has twelve lever master element section control. It is designed to test standard receiving and low power transmitting tubes including acorns, noval 9 pins, dual capped h-f amplifiers, etc.

The tester circuit is pushbutton operated, has 34 a-c and d-c ranges, plus radio A, B and C battery test facilities. All standard set testing functions are said to be available at only two polarized tip jacks. It has a 400-microampere, 4⅝-in. meter.

Ranges of the instrument are: output voltages 6 to 3,000; resistances 1,000 ohms to 10 megohms; d-c current 600 microamperes to 12 amp, decibels −20 to +64.

•

Semi-Silvered Bowl Lamp



FOR VARIED store lighting applications, General Electric Lamp Department at Nela Park, Cleveland, Ohio, recently announced a new 200-w semi-silvered bowl lamp. This lamp has a medium screw base. It is a companion size to the other two previously announced lamps which are rated at 300 and 500 w and are equipped with mogul type base.

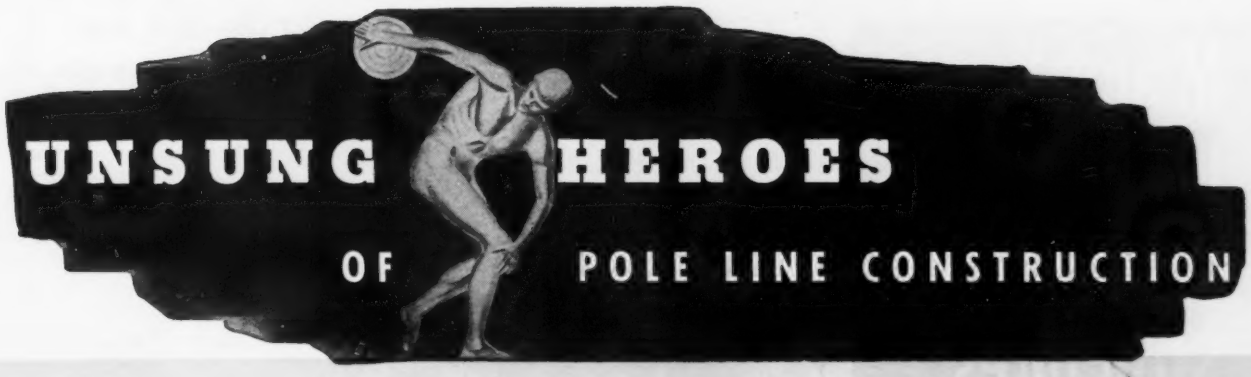
All three lamps have a circular inside-frosted "window" at the end of the bulb to provide downlighting. Other data pertaining to the new "200" are as follows: PS-30 bulb; C-9 filament; base-up burning position; and 1,000-hr life.

•

Selenium Rectifier

A SELENIUM RECTIFIER, said to maintain constant voltage regardless of the changing amounts of current drawn from it, is being marketed by La Marche Manufacturing Co, 6525 Olmsted Ave, Chicago 31, Ill.

This rectifier was construoted to handle large gangs of low-voltage d-c magnets in varying loads of from zero to 20 amp with no appreciable variance in voltage. The d-c voltage control of reactor type is to maintain or increase



Simple things, CROSS ARM BRACES; just a strip of flat steel with a hole punched in each end, but most important to a pole line. Hubbard Braces are fabricated from the best, new, open-hearth steel and all corners are rounded to protect linemen from sharp projections. For the engineer who wishes additional strength on the compression side of the arm, the ribbed brace is provided and offers approximately 25% added protection.

HUBBARD FLAT AND RIBBED
CROSS ARM BRACES

HUBBARD ANGLE CROSS ARM BRACES, for heavy construction, are supplied in a range of spreads and drops to meet the requirements of any standard construction. Angle size runs from 1½ to 2-inches. At the pole attachment hole, the angle is so formed that wrench clearance is provided. Attachment is by ⅝-inch Machine Bolt at the pole and ½-inch Carriage Bolts at the arm.

HUBBARD ANGLE CROSS ARM BRACE

DRIVE POINT MACHINE OR CROSS ARM BOLTS are roll-threaded to provide a "finger-fit" for the full length of the thread. The "Drive Point" feature enables the bolt to be used as a drift pin for the alignment of holes slightly off center. This operation must be carried out with caution so as not to injure the threads. "Drive Point" also facilitates the application of nuts and allows bolts to be driven out of the pole for reclamation without injury to the threaded end. The major portion of Hubbard bolts of all types have this feature.

HUBBARD DRIVE-POINT
CROSS ARM OR MACHINE BOLT

HUBEYE BOLTS are furnished for attachments of any kind where a thimble would normally be used. The eye of the bolt is drop-forged to a shape which provides a perfect "built in" thimble. Strand may be looped around the Hubeye with complete protection. Side walls of the eye retain the roundness of the strand. There is no possibility of kinks or strains at the loop. Hubeyes are a thoroughly tried and proven product.

HUBEYE DRIVE-POINT BOLT

STANDARD HUBBARD OVAL-EYE BOLTS are an old line item still much used in many sections. Hubbard Eye Bolts are all drop-forged with an eye that is stronger than the shaft of the bolt. Made from the best, new, open-hearth steel and Hubbard Double-Dip Hot Galvanized.

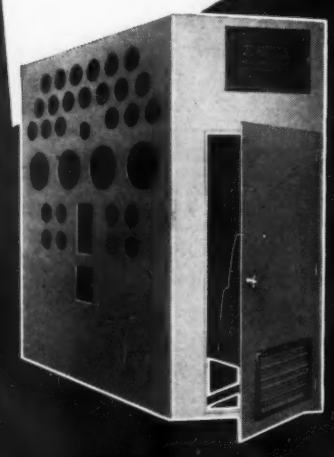
HUBBARD OVAL-EYE
DRIVE-POINT BOLT

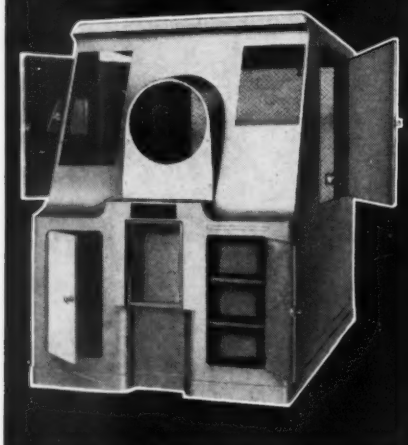
HUBBARD AND COMPANY

PITTSBURGH CHICAGO OAKLAND CALIF.

Mount Your Instruments on Littleford Structures

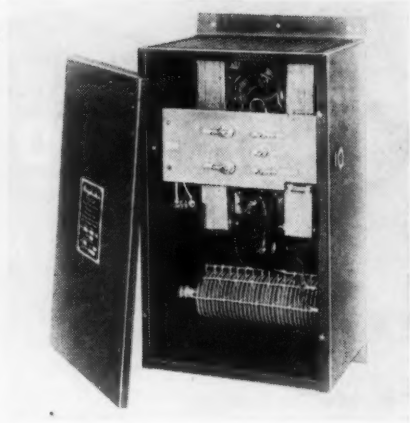
Come to Littleford, where engineers' long years of experience assure you exacting fabrication of even the most intricate structures. Skilled workmen here shape, form and weld good steel into fine cabinets, cubicles, mechanism boxes, panels, control boxes. Consult this leading fabricator about your requirements.





LITTLEFORD

LITTLEFORD BROS., INC.
421 E. Pearl St.
Cincinnati, 2, Ohio



the starting voltage until the full amperage has been drawn from the rectifier.

The rectifier itself is a full-wave bridge type suitable for any a-c frequency and a line voltage of 115 to 230. The pulsating direct current is filtered about 25 percent but a smoother current can be supplied if necessary. The rectifier occupies about a cubic foot of space.

•

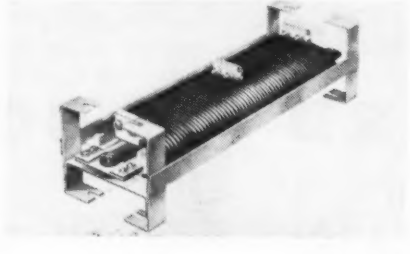
High-Current Resistors

DEVELOPMENT of its Edgeohm high-current resistors is announced by Ward Leonard Electric Co, Mount Vernon, N. Y. These resistors are applicable for intermittent-duty, high-current applications and also for continuous-duty uses on a-c and d-c circuits.

Edgeohm resistors consist of a continuous piece of non-corrosive alloy ribbon wound on edge in the form of oval coils, having clamp type terminals secured to the ends of the coils. The element is mounted on two steel straps each carrying grooved ceramic saddles.

Standard units are rated at 2,200 w for continuous duty, being available with resistances from 0.32 to 4.35 ohms and with continuous current capacities from 21 to 79 amp. A single resistor with a duty cycle of 5 sec on out of each 80 sec is rated at 17,000 w, based on a 375 C temperature rise.

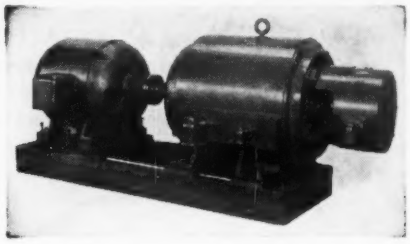
Single Edgeohm resistors are available with stamped steel brackets while multiple units up to four can be furnished in a single open frame. Frames of the same length and width may be stacked in banks.



360-Cycle M-G Sets

GENERATING EQUIPMENT for 360-cycle service is an addition to the 180-cycle line produced by Burke Electric Co, Erie, Pa. The motor-generator sets are standard in ratings of 6.25, 12.5, 25 and 62.5 kva, are two-unit, four-bearing type coupled and mounted on a common subbase.

The 60-360 cycle sets are driven by squirrel-cage motors and are designed for operation at 3,600 rpm, 220/440 or



550 v, 2- or 3-phase input. D-c motor drive is also available. The generators are designed for 230-v, 3-phase output, 80 percent power factor, continuous duty, 40-C rise, for inherent voltage regulation of 8 percent maximum, and have direct connected exciters. A generator panel is included with each set

•

X-ray Tubes

TWO NEW x-ray tubes, types AV-3E and AV-3K, have been announced by Amperex Electronic Corp, 25 Washington St, Brooklyn, N. Y. The two valves are identical except that the AV-3E makes filament connections through an Edison screw base while the AV-3K utilizes two pin terminals.

Maximum peak voltage rating for either continuous or intermittent operation is 125 kv. Maximum load current is 50 ma for continuous operation and 200 ma for intermittent operation.

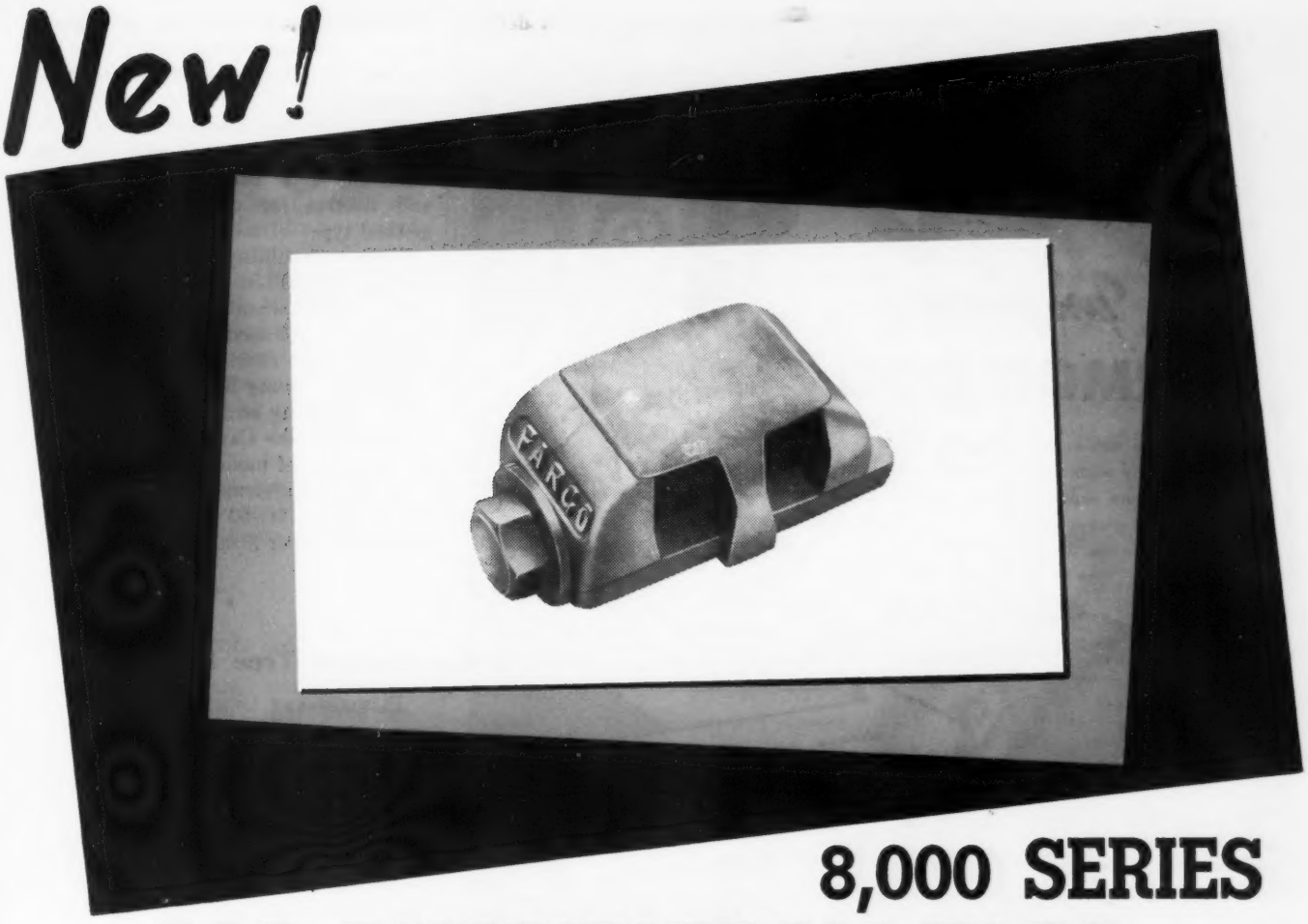
Over-all length is 10½ plus or minus $\frac{1}{16}$ in. for type AV-3E and 10¾ plus or minus $\frac{1}{16}$ in. for type AV-3K. Maximum diameter is 2½ in. Envelope is made of Pyrex and cathode consists of a loop-type tungsten filament. Both valves are designed for oil-immersed cooling systems.

•

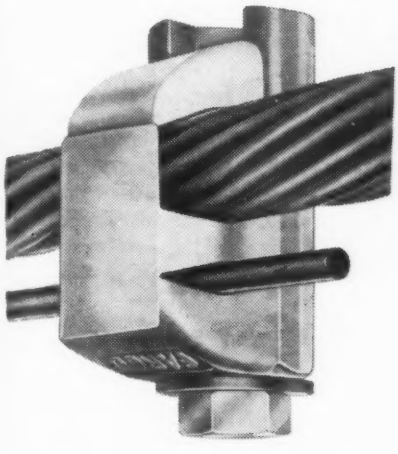
Electronic Recorder

A STRIP CHART RECORDER, the Capacilog, which operates on an electronic principle, has been released by Wheelco Instrument Co, 847 West Harrison St, Chicago 7, Ill. This "Electronic Scriber" is designed for the measurement indication control and permanent record of variables in the process industries. It

New!



8,000 SERIES FOR DISTRIBUTION TAPS



FARGO'S VISE TYPE DESIGN

One piece construction. No loose parts. Always threaded.

ELECTROLYTIC COPPER SPACER

For better conductivity.

SIZE FLEXIBILITY

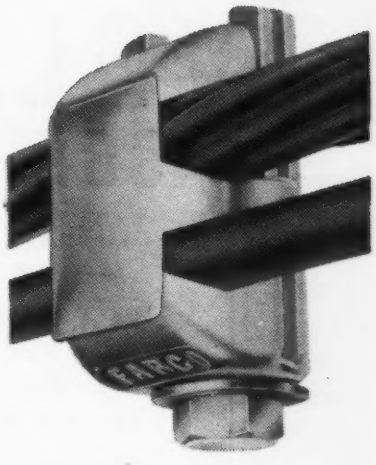
Only six sizes for a range from 8 sol. to 500 MCM-397,500 ACSR.

THREE TYPES

Bronze body, copper spacer for copper to copper.
All aluminum for aluminum to aluminum.
Plated bronze body and plated copper spacer for aluminum to copper, etc.

FAST INSTALLATION

1. Hook on run. 2. Insert tap. 3. Tighten bolt.



A FARGO PRODUCT

DISTRIBUTED BY
LINE MATERIAL COMPANY
MILWAUKEE, WISCONSIN

Opens Wide . . . Easily and speedily installed without removing nut, lock-washer and bolt.
Improved
ARMOR ROD CLAMPS
Clamp bodies are a special silicon aluminum alloy having exceptionally high tensile strength and corrosion resistance. No. R-101 has pure copper liner bonded by special process in small groove. Large groove for #6 to 1/0 ACSR over armor rods. Write for Bulletin No. 25 giving full data.
H. B. SHERMAN MFG. CO.
BATTLE CREEK, MICHIGAN
Unique, Interlocking Construction. Clamp automatically adjusts itself to fit all usual sizes of wire.

THE
WELSBACH
CORPORATION
UTILITY MANAGEMENT
CONSTRUCTION
STREET LIGHTING MAINTENANCE
CONSULTANTS ON ALL
PHASES OF UTILITY OPERATION
WELSBACH
1500 WALNUT ST., PHILA. 2, PA.

is available as a deflection, potentiometer or resistance thermometer type recorder, recording controller or indicating controller.

The recording function with a positive power-driven pen is added to the electronic link between measurement and control for deflection and null method types of measuring systems.

Front accessibility provides for maintenance. The 10-in. chart has an automatic reroll when the "pulled out" section is released after inspection. The aluminum chart assembly is hinged and can be swung forward.

For operating on 115 or 230-v, 25, 50 or 60 cycles, the Capacilog is available in a number of models utilizing a variety of control systems. Maximum power consumption is 60 w. Chart speed standard is 1 or 2 in. per hour.

•

Outdoor Tree Lights

FLUORESCENT LIGHTS for decorations are now available for use on trees outdoors in cold weather as well as indoors, according to an announcement by Sylvania Electric Products, Inc, 500 Fifth Ave., New York 18, N. Y. The new sets have waterproofed cords and are equipped with special gaskets to be placed inside the sockets for protection from the elements.

The fluorescent bulbs are soft blue, green, coral, yellow and orchid colors, have a screw type base, and are independently operated. Each lamp consumes about 4 w and has an average life of 1,000 hr. The strings need no auxiliary equipment in order to operate.

•

Rotary Indicator

AN INDICATOR UNIT displaying numbers from 1 to 10 and featuring noiseless operation has been produced by Stevens-Arnold Co, 22 Elkins St., South Boston 27, Mass. The numbers are

printed on a rotating cylinder and displayed through an opening at one end.

The unit is applicable where remote indication is required such as annunciators, totalizers, clocks, telephone systems, stock quotation boards, train announcing systems, and air traffic control systems. The entire unit is 1¼ in. square and 3 in. long. Each character is ¼ in. wide and ⅝ in. high. Other characters may be supplied.

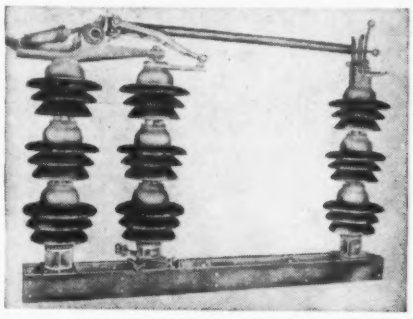
The indicator is operated magnetically and reset is accomplished automatically with a spring return. Power requirements are 48 v, d-c, 0.043 amp. Operation is stated to be obtained reliably up to 15 steps per second or a total of 0.7 sec. for complete step-by-step operation from figures 1 to 10.

•

Airbreak Switch

A VERTICAL-BREAK, rotating-blade-type, airbreak switch has been announced by Schwager-Wood Corp, 7634 S. W. Capitol Highway, Portland, Ore. A single lever is used to accomplish the initial rotation and the subsequent lifting of the blade.

Current range is 600 to 1,200 amp



and voltage range is 46 kv to 230 kv. For 69 kv and above counterbalancing is provided. The design permits installation in horizontal position without additional parts.

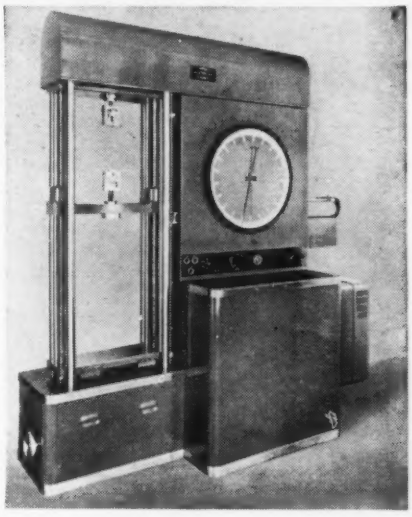
The switch is supplied as a disconnecting switch or as a horngap switch. Since the blade hinges above the rear insulator (center insulator column rotates), a substantial increase in horizontal break distance is stated to be obtained and to make the switch effective for the interruption of exciting currents and charging currents of transmission lines.

•

Testing Machine

A NEW TYPE of Baldwin-Tate-Emery testing machine has been built at the plant of A. H. Emery Co, Stamford, Conn. It has been designed primarily for precision testing of plastics, rubber, nonferrous metals, textiles, fibers and similar materials. Maximum capacity is 5,000 lb.

The machine uses a mechanical screw system. Loading crosshead is driven by



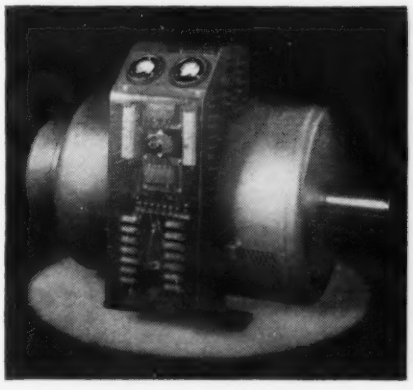
two screws. These screws are rotated by a 1:1 or 10:1 gear transmission which is driven by a variable speed motor with GE Thymatrol control. Speed of loading is steplessly variable from 0.05 in. to 20 in. per min. and can be held constant within plus or minus 2 percent.

Standard Baldwin accessories are used, such as Templin grips, Baldwin extensometers, compressometers, deflectometers, subpresses and flexure tools as well as special grips required for various materials.

•

"Packaged" Generators

NEW "PACKAGED" GENERATOR has been developed by Electric Machinery Mfg Co, Minneapolis, Minn., for use in engine-generator sets. The factory-assembled unit includes revolving-field generator, direct-connected exciter, automatic voltage regulating circuit,



meters, and selector switch for pre-setting voltage. Only external connections needed are leads to a generator switch.

The built-in automatic voltage regulating circuit has no moving parts and requires no maintenance. It is permanently connected and factory-adjusted to hold terminal voltage within 2 percent of the voltage selected, at any load or power factor within the generator rating.

Popular 60-cycle ratings at standard voltages and 0.8 power factor include: 18.7, 25, and 31.3 kva at 1,200 rpm; also 25, 31.3, and 37.5 kva at 1,800 rpm.

The principle of electrical resonance, long used for needle-sharp tuning of radios, is used to hold constant voltage.

•

Barbecue Oven

A NEW ELECTRIC BARBECUE OVEN, which roasts meat and adds smoke flavor by the heating of hardwood in the oven, is being manufactured by the Plantation Manufacturing Co, Portland, Oregon.

Cooking temperatures are controlled automatically and the amount of smoke can be regulated to vary the flavor. Loss from shrinkage is said to be reduced to a minimum by use of heavy insulation.

A large commercial size which will handle 40 lb of meat is in production. A medium size for restaurants and a small size for residential use are planned for marketing. Connections are for commercial voltages.

•

Multi-Breaker

A NEW 1- and 2-pole Multi-breaker type M02 has been introduced by the Square D Co, Switch and Panel Division, Detroit, Mich. It is suitable for serving lighting appliance and small motor circuits in homes, stores, offices, factories, farms and as service entrance equipment.

The breaker features a thermal-(coilless) magnetic trip which provides in-

Christmas gift for him or her that'll go to work for you!

Under many a Christmas tree this year, there'll be a gift that can be a load-builder for your off-peak hours . . . the famous General Electric Automatic Blanket.

This electrically controlled blanket "works" for you from bedtime to breakfast time, when you need the load most. *Two* Blankets equal one six-foot refrigerator in electrical energy consumption.

Why not mention this gift possibility to your customers?

Tell them how marvelous it is to sleep under ONE lightweight covering —while the exclusive Bedside Control adjusts *automatically* to room temperature changes—keeps the sleeper snug all night long!

This year, General Electric offers *two* exclusives! The Two-Control automatic blanket for double-bed sleepers who like *different* degrees of sleeping warmth. And a new *Twin-Bed size* in the One-Control model.

Remember, *only* G.E. has such a *complete* automatic blanket line.

We're advertising General Electric Automatic Sleeping Comfort to your customers in Christmas magazine ads —and on the coast-to-coast radio show, "The G-E House Party."

If you'd like more information about how this marvelous blanket can be a load-builder for *you*, write today . . . Appliance and Merchandise Dept., General Electric Company, Bridgeport 2, Conn.

Automatic Blanket

"Goes to work when the lights go out"
Approved by Underwriters' Laboratories, Inc.

GENERAL ELECTRIC

stant tripping on short circuits but which holds on harmless overloads. The magnetic trip functions in 1/50 to 1/100 of a second, even on minor short circuits. it is stated. This magnetic trip feature is combined with a thermal bimetal element which provides time-delayed tripping on moderate overloads.

These new breakers are furnished in 1947 NEC ratings of 15, 20 and 30 amp, 120/240 v, a-c, flush or surface types.

•

Induction Heater

FOR REMOVING roller bearing inner races on axles or shafts such as on railroad car axles, a portable induction heater has been developed by Hyatt Bearings Division, General Motors Corp, Harrison, N. J. The coil has been designed to function with a race up to 8⅜ in. OD.

The unit is designed to operate on 440-v, 60-cycle supply and draws a minimum of 200 amp. It is for intermittent duty only, approximately 2 min cumulative total heating time. Removable covers are provided to shorten the cooling cycle of the heater.

In operation, the current is on for 35 sec maximum. This time is reported to be ample to expand the race approximately 0.010 in. and break any shrink fit recommended for an inner race on a journal.

The heater can also be used in applying new or used inner races. It has handles on both sides for lifting by one man to the journal.

•

Foot Control Switch

A NEW LINE of momentary contact foot-control switches has been developed by Hart Manufacturing Co, 110 Bartholomew Ave, Hartford, Conn. The cir-

cular units are adaptable for appliance and industrial use. They may be mounted either on the floor or a machine by means of two screws, or used unmounted. The design permits loadings up to 35 amp, 115/230 v, a-c.

Butler Built Package Buildings Save You Money; Meet Immediate Needs

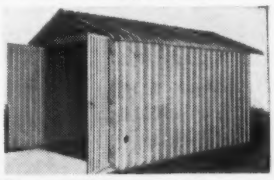
You want a small steel building now. You want to erect it quickly. Here's your answer — Butler-Built Package Buildings. Butler engineers have developed these low cost structures with wide flexibility in design. The electrical industry is using them now—hundreds of them—for power stations, warehouses, machine shops, materials depots, many other purposes.

Butler Steel electric power station. Size, 20′ x 30′ x 10′

Butler package buildings have continuous sheeting at the corners. This cuts hand-fitting time and gives weather-tight permanency. The roof ridge is of one piece, die-formed. This eliminates ridge roll, increases strength, cuts erection time and prevents leakage. Butler deep drawn corrugated sheets of 24 gage galvanized steel have triple the strength of ordinary sheets. Buildings are easily insulated. Furring clips which bolt into the wall sheets hold furring strips for attaching interior wall linings.

Butler Built machine shop for repairing field equipment. 24′ x 36′ x 10′.

Service doors on Butler package buildings are of heavy galvanized steel. Sides and ends are folded to form a sturdy frame. Panels are welded in place and durable hardware is built in. You can get Butler single or double doors, swing or slide type. All are constructed with a substantial angle iron frame and extra-strength Butler wall sheets. Doors are weather-tight and feature easy finger-tip movement. Steel windows are especially adapted for use in steel walls and are flanged for weather tightness.



Single garage, Butler-Built, for all size cars and pick-up trucks. Also available in multiples of 2, 6, 8 and 10 units.

These adaptable, speedily erected package buildings are in production now, their quantity limited only by delivery of materials. They come in 29 small industrial types, which can be shipped quickly . . . uncrated quickly . . . erected quickly.

See your nearest Butler dealer or distributor for full information, or send coupon today. With your specifications Butler engineers will be glad to help you plan your future expansion.

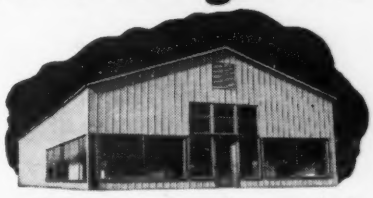
BUTLER MANUFACTURING COMPANY

Printed in U. S. A.

BUTLER BUILT

Reg. U. S. Pat. Off.

Steel Buildings...Aluminum Covered



You use all of the space in Butler Built, Aluminum Covered Steel Buildings—wall to wall, floor to truss-free roof. Readily adapted to industrial, commercial and farm uses.

This, plus the savings you get from low initial cost, minimum freight and trucking charges, speedy labor-saving erection and small upkeep expense add up to less overhead. Deep drawn corrugations in .026 aluminum (thicker than 24 gage) provides long life.

EASY TO ERECT

You can buy Butler Built Aluminum Covered Steel Buildings in 40 ft. width, and length in any multiple of 20 ft. Also in 20 ft. and 32 ft. widths with lengths in any multiple of 12 ft. See how quickly and easily you can adapt them to your plans for expansion or new construction. See your nearest Butler dealer or distributor, or mail coupon today for detailed illustrated booklet.

The Mark of BUTLER *Better Quality*

COPYRIGHT 1947, BUTLER MFG. CO.

BUTLER MANUFACTURING COMPANY

FACTORIES: KANSAS CITY, GALESBURG, MINNEAPOLIS

Send Complete Information on Butler-Built Aluminum Covered Steel Buildings.

Size _____ ft. wide x _____ ft. long

Address Inquiries to:
7336 East 13th St., Kansas City 3, Mo., or
936 Sixth Ave. S. E., Minneapolis 14, Minn.

NAME _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

NEWS ABOUT PEOPLE

Kennedy Elected Executive V-P by Oklahoma Utility

Oklahoma Gas & Electric Co has announced the promotion of Donald S. Kennedy to executive vice-president and of W. B. Gesell and W. R. Wolfe to

D. S. KENNEDY

vice-presidencies.

Mr Kennedy fills a vacancy created five years ago when George A. Davis became president of the company. He joined the utility's accounting and auditing department in 1923 following graduation from the University of Arizona with a degree in accounting

W. B. GESELL

and economics. He became treasurer of the company in 1942.

Mr Gesell held the position of executive assistant before his recent promotion. He has been identified with OG&E

W. R. WOLFE

more than 20 years, starting in the rate department.

A graduate of the University of Oklahoma, Mr Wolfe has specialized in power sales engineering and for many years was manager of the company's eastern division, with headquarters at Muskogee. He is a graduate of the University of Oklahoma, having received his E. E. degree in 1926.

•

► FRED B. WILSON, assistant to the president of the Georgia Power Co, Atlanta, since 1932, has resigned to devote his entire time to his other business interests.

► CARROLL T. SINCLAIR, chief engineer in charge of engineering and construction, Duquesne Light Co, Pittsburgh, has taken over the duties formerly performed by the late Arthur G. Butler. Mr Sinclair will retain his former title. He has been connected with the organization since 1925. Since then he has handled many general and specialized problems for the company. He is a fellow and past vice-president of the American Institute of Electrical Engineers and a member of the Pennsylvania Electric Association, Edison Electric Institute, Association of Edison Illuminating Companies and the American Standards Association. He has made many contributions to the technical press and has served as chairman of a number of the committees of the various associations to which he belongs.

Utah Power & Light Names Ashworth Vice-President

Promotions of three to ranking executives, one to a vice-presidency, have been announced recently by Utah Power & Light Co. At the same time the company announced retirement of a fourth veteran executive.

Promoted were:

Roy H. Ashworth, commercial manager since 1944, to vice-president in

R. H. ASHWORTH

charge of the company's commercial and division affairs.

Olin H. Ririe, manager of the southern division, to Ogden division manager.

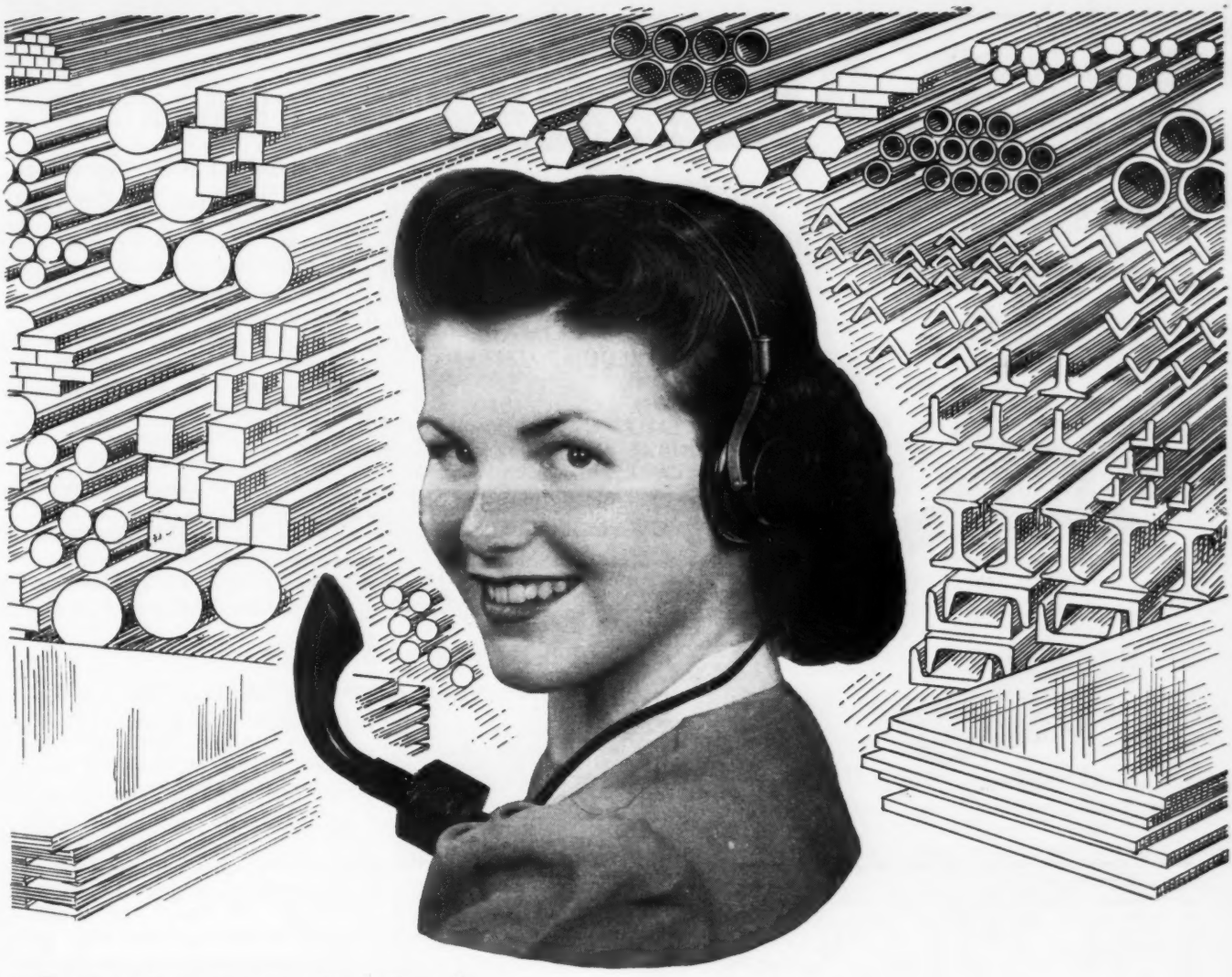
Orson M. Slack, senior industrial salesman for Ogden division, to succeed Mr Ririe as southern division manager.

Retired was C. A. Wolfrom, for 20 years manager of the Salt Lake division.

Mr Ashworth has been a power company employee for more than 34 years. A graduate of University of Minnesota in electrical engineering, he had served in the company's statistical department, as assistant to the general manager and as general superintendent prior to becoming commercial manager.

Mr Ririe was first employed by U P & L in 1923 as a meter reader and was promoted to managership of the southern division in 1941. Mr Slack started with the company in 1917. He was assigned to the northern division as senior industrial salesman in 1940.

Mr Wolfrom started with Telluride



when it comes to steel—

Our Business is YOUR Business

You can simplify steel purchasing for every power generating requirement with a call to your nearby Ryerson plant. We plan our stocks to meet your needs and, when it comes to steel, our business is your business.

For almost a hundred years Ryerson specialists have been working with the utilities and their equipment manufacturers—quickly supplying the right steel for every application. Now, during times of great demand, Ryerson stocks and Ryerson experience are especially helpful.

Whether your requirements are measured in pounds or tons, they receive the immediate attention of experienced steel men. And if the steel you need is not readily available from stock, Ryerson know-how goes to work. Often we can suggest a practical alternate steel.

So contact Ryerson when you need steel for new construction or maintenance. Let one order to Ryerson, one invoice and one shipment do the job; save you time and money.

Joseph T. Ryerson & Son, Inc. Plants: New York, Boston, Philadelphia, Detroit, Cincinnati, Cleveland, Pittsburgh, Buffalo, Chicago, Milwaukee, St. Louis, Los Angeles.

PRINCIPAL PRODUCTS

SHEETS — Incl. Allegheny stainless, many others

TUBING — Welded & seamless boiler tubes, mechanical tubing

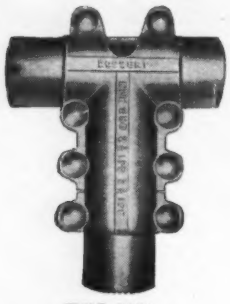
MACHINERY & TOOLS — For metal fabricating & boiler shops, etc.

BARS—Carbon & alloy hot rolled & cold finished

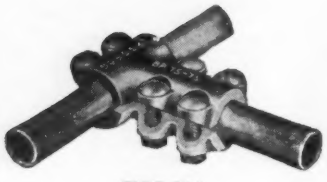
STRUCTURALS — I beams, H beams, channels, angles, tees, zees

PLATES — Inland 4 - Way Floor Plate, etc.

RYERSON STEEL



TYPE BPEA



TYPE BPA

TYPE TPA

DOSSERT CONNECTORS

ALUMINUM POWER CONNECTORS

SPECIFY DOSSERT ALUMINUM CONNECTORS FOR YOUR NEXT POWER OR SUBSTATION REQUIREMENTS

DOSSERT POWER CONNECTORS ARE READILY AVAILABLE IN ALL COMBINATIONS OF TUBULAR AND FLAT BAR BUS, WIRE AND CABLE FOR CONDUCTORS COPPER TO COPPER, ALUMINUM TO ALUMINUM, AND ALUMINUM TO COPPER.

"Insist on Genuine Dosserts"

TO BE SURE OF A GENUINE "DOSSERT" MAKE SURE THE NAME "DOSSERT" IS ON YOUR CONNECTOR.

Send for Catalog 45-1

DOSSERT MFG. CORP.
249-255 HURON STREET, BROOKLYN 22, N. Y.
SINCE 1904

New-Improved!

SMALL, COMPACT, PORTABLE, SAFE EASY TO OPERATE

"HYPOT"
(Trademark Registered)

High Voltage Insulation Breakdown Tester

The many outstanding features of the Associated Research, Incorporated, model 404 "HYPOT" make this the most desirable instrument for factory, laboratory or electrical repair shop.

Two indicator lights discriminate between breakdown and leakage. Direct ratio between applied voltage and insulation leakage resistance—accurately calibrated meter in secondary reads actual voltage applied—output voltage unaffected even with load equivalent to ¼ megohm across terminals—range 0-4000 volts continuously variable from 0 to maximum—shielded high voltage leads—grounding clip at end of line cord. Sturdy metal case makes instrument readily portable. These and many other features are described fully in bulletin No. 302.

Also available: "Vibrotest" insulation resistance tester—"Vibroground" ground resistance tester—cable fault locators—soil resistivity meters—limits bridge—ammeters—ohmmeters—current transformers.

Send for yours today.

ASSOCIATED RESEARCH, Incorporated
"Precision instruments since 1936"

233-B S. Green Street, Chicago 7, Illinois

Power Co as station operator in 1902. Since 1927 he had been Salt Lake division manager.

•

Colorado Utility Appoints Bullock Vice-President

James A. Bullock, general manager of the Western Colorado Power Co, Durango, since 1937, has been appointed vice president.

Mr Bullock began his utility career in 1909 with the old Telluride Power Co in Utah, later being transferred to Telluride properties in Colorado, where he played an important role in the pioneering development of alternating current in the Savage Basin-Telluride district.

Details of Mr Bullock's career were published last fall when he was elected president of the Rocky Mountain Electrical League (EW Oct. 4, page 27).

•

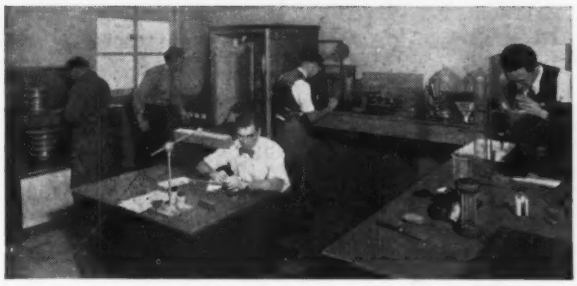
► C. W. MARSHALL has been appointed as deputy chief engineer (research) of the British Electricity Authority. Since 1927 Mr Marshall has been technical and research engineer to the Central Electricity Board.

► SAMUEL INSULL JR has been elected vice-president of Stewart-Warner Corp, Chicago. Mr Insull will continue in charge of the company's radio division. Prior to his appointment as assistant to the president of Stewart-Warner early this year, Mr Insull was vice-president of Central Barge Co, Chicago. He was engaged in the utility business from 1922 to 1938.

► PHILIP D. REED, chairman of the board of the General Electric Co, has been awarded the President's Certificate of Merit, the second highest award available to civilians. Mr Reed was cited for outstanding services as deputy and later as chief of the Mission for Economic Affairs in Great Britain from July, 1942, to December, 1944, "which proved to be an invaluable contribution to the war effort of the United States."

► COL JOSEPH S. GORLINSKI, who at one time was in charge of construction of Bonneville Dam, has been made chief of the Sacramento district for the U. S. Corps of Engineers. Col Gorlinski replaces Col Lester F. Rhodes as head of the district, which includes northern and central California, all of Nevada and western Utah. Col Rhodes was transferred two months ago to a new assignment at Potsdam, N. Y. Col Gorlinski's latest tour of duty was in China. In 1944, he was assigned to

What it takes to make a *better* dust collector



Thousands of dust particles are examined here

With the advent of pulverized coal as fuel for Power Plants, the efficiency required of dust collectors has steadily increased to a point considered unattainable ten years ago.

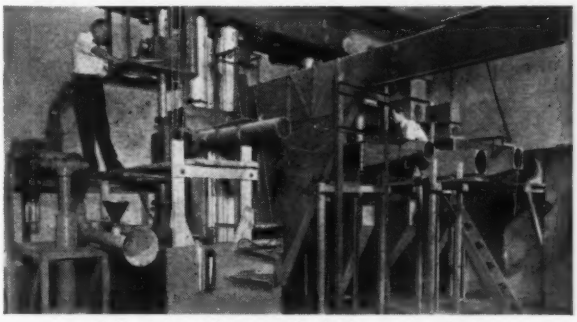
As far back as 1926, Prat-Daniel first applied the principle of centrifugal force to dust collection . . . a principle still used as the basis for the highly efficient Thermix collectors of today. Yet, today, with world-wide installations to their credit, Prat-Daniel still searches for better designs and developments in this important field.

The physio-chemical and testing laboratories, shown here, are only a part of the extensive research constantly carried on by Prat-Daniel, in an effort to find more efficient means of dust control.

One of the interesting sidelights of the testing laboratory is the use of full size collector elements for determining efficiency. This method provides an extremely accurate check, compared to the usual laboratory method of scale model testing. Obviously, results will be comparable to the final installation, composed of a greater number of such elements.

This continuous quest for the ultimate in dust control has paid dividends in placing Prat-Daniel as the leader in its field.

Our Project Engineers will be glad to show you how your plant operation can be improved by the use of more efficient equipment.



Full scale collector units being researched

Research points the way to better dust control

All inquiries should be directed to **THE THERMIX CORP.** PROJECT & SALES ENGINEERS
FIRST NATIONAL BANK BLDG., GREENWICH, CONN.
(Offices in 28 principal cities)

Equipment designed and manufactured by

PRAT-DANIEL CORPORATION

Manufacturing Plant, EAST PORT CHESTER, CONN.

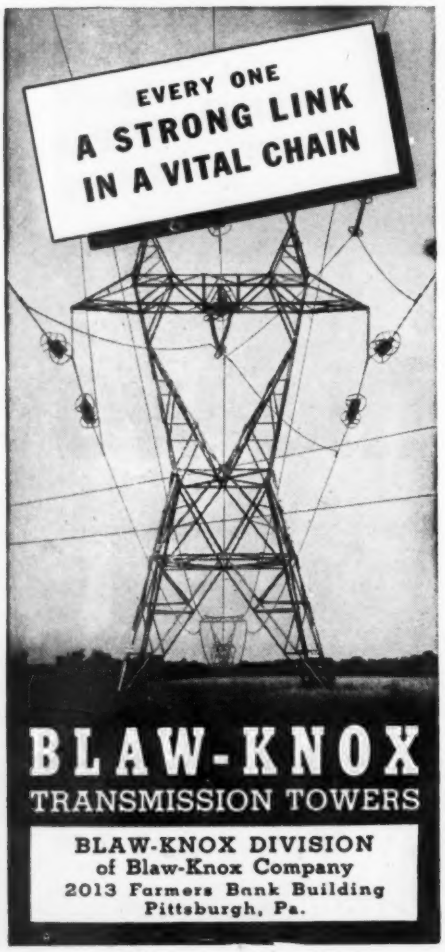
THERMALARM

So Inexpensive For So Big A Job.

. . . PROTECTING TRANSFORMERS!

THERMALARM is a simple, inexpensive device . . . but has the big job of telling you whether your transformer is too hot. A red flag shows when there's excessive heat, and your inspectors know at a glance if there's dangerously high temperature. THERMALARM is easily, quickly, installed on transformers with special adhesive cement (no tools needed). Is fool-proof, accurate, and will operate indefinitely. WRITE TODAY FOR FULL DETAILS.

Eastern Specialty Co.
PHILADELPHIA 40, PA.



BLAW-KNOX
TRANSMISSION TOWERS
BLAW-KNOX DIVISION
of Blaw-Knox Company
2013 Farmers Bank Building
Pittsburgh, Pa.

General Albert C. Wedemeyer's staff as chief engineer, and stayed on after the war with an Army advisory group. He was resident engineer in charge of construction at Bonneville Dam from 1934 to 1936. From 1940 until 1944 he headed the war plans division in the office of the Chief of Engineers in Washington, D. C.

▶ JAMES L. ADAMS, senior assistant distribution engineer, Union Electric Co, St. Louis, recently was promoted to planning engineer. Mr Adams has been affiliated with Union Electric since July, 1941.

▶ MAXWELL V. SAUER, hydraulic engineer and general superintendent of generating stations of the Quebec Hydro-Electric Commission, has recently been awarded the Keefer Medal of the Engineering Institute of Canada for the best paper on a civil engineering subject presented to the Institute during its 1943-44 season. The paper, "St. Lawrence River Control and Remedial Dams — Soulanges Section," was presented by Mr Sauer at the October meeting of the Montreal branch of the Institute.

▶ JOHN T. SHEWMAKE has been elected a vice-president of the Southwestern Electric Service Co, Waco, Tex. He has been connected with the company since 1945, when he was released from active duty as Major in the Army Engineers. A graduate of Georgia Tech, he was for a number of years prior to entering the army with several utility companies affiliated with Stone & Webster, Inc. At the present time he supervises engineering, commercial and purchasing activities of the company.

▶ DEAN HOLDEN, formerly president of the Holdenline Co, Cleveland, has become chairman of the board. This change frees him from active company management to devote his full time to all-industry work. He will retain his full financial interest in the company and participate in all problems of lighting design. HARRY INGRAHAM has been elected president and general manager and GARY WISE was made vice-president. Both Mr Ingraham and Mr Wise have been associated with Mr Holden since early fluorescent days.

▶ NIDA BOAZ, affiliated with the Public Service Co of Oklahoma for more than 23 years, and former secretary to R. K. Lane, president of the company, has been elected secretary of the company. Miss Boaz will fill the position formerly held by RUBY F. FRANK, who has retired under the company's annuity retirement program. Miss Frank had been connected with Public Service in an executive capacity for 34 years.

Radio Engineers Elect Shackelford President

The Institute of Radio Engineers has announced the election of Benjamin E. Shackelford as president for the year 1948. Dr Shackelford has been a fellow of the IRE since 1938. He is manager of the license department of RCA international division, New York, N. Y., and in addition, assistant to the vice-president in charge of RCA Laboratories. He is a member of the American Institute of Electrical Engineers, the American Association for the Advancement of Science and of other technical societies.

•

▶ M. E. COMSTOCK has been appointed manager of Wagner Electric Corp's electrical division branch office in Boston. Mr Comstock has been with the company since 1919 and prior to his recent appointment held the position of sales engineer for 28 years.

▶ DR GEORGE W. VINAL, battery expert and chief of the Electrochemistry Section of the National Bureau of Standards, has been awarded the certificate of commendation by the Bureau of Ships of the Navy Department. Dr Vinal is internationally recognized for his research in the field of electrochemistry. He is chairman of the battery committee of the Electrochemical Society, chairman of the dry battery and storage battery committees of the American Standards Association and fellow of the American Institute of Electrical Engineers and of the American Association for the Advancement of Science.

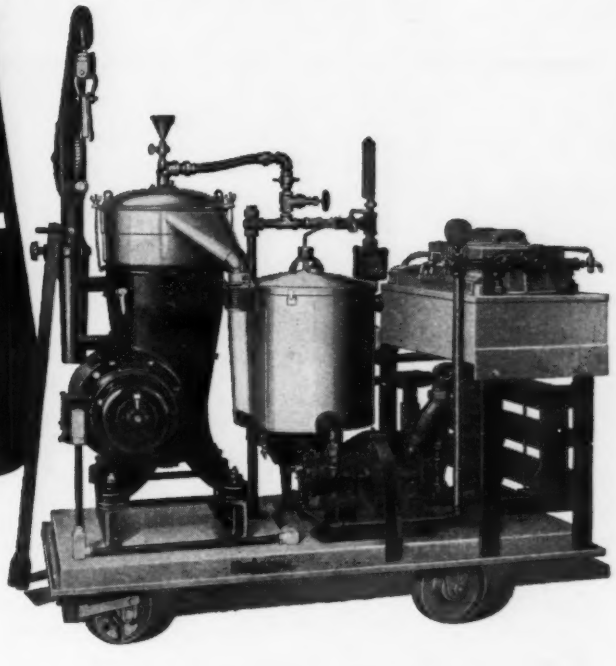
OBITUARY

▶ TAYLOR P. WILLERTON, chief inspector for the Commonwealth Edison Co, Chicago, died in that city on December 4. Mr Willerton had been identified with Commonwealth Edison for 37 years. He was a member of the Chicago Electric Commission.

▶ RALPH P. ORMSBEE, 58, vice-president and a director of the Narragansett Electric Co, Providence, R. I., died at Rumford, R. I., on Dec. 8. He joined the company in 1916 as general utility engineer in the distribution department. In 1929 he became superintendent of distribution, assistant general manager in 1930 and almost at once, vice-president. Mr. Ormsbee was also a vice-president of the Rhode Island Power Transmission Co, another affiliate of the New England Electric System, and was prominent in civic affairs.

DEHYDRATE AT A SINGLE PASS—

NO RE-RUNNING IS NECESSARY



ADVANTAGES OF DE LAVAL INSULATING OIL PURIFIERS

Constant high purifying efficiency—no shutdowns for cleaning or for renewal of parts during run

•

Higher daily capacity of purifier saves maintenance costs

•

★ **Dehydrates at a single pass—no re-running**

•

More economical to operate

•

Safest — continuous discharge of water prevents re-contamination of the insulating oil

•

Heater cannot carbonize the oil

•

Low temperature purification; high dielectric value of oil maintained longer

•

Removes water without aid of filter press; press used only to remove colloidal carbon

DE LAVAL Insulating Oil Purifiers are used by leading power systems largely because of one outstanding superiority: by means of centrifugal force they purify and dehydrate the oil most completely at a single pass. This feature enables operators to maintain their oil at lowest cost and at highest efficiency.

When insulating oil is purified at a single pass, there is a greater daily output of thoroughly dehydrated oil, operating costs are lower and the oil can be restored to a high dielectric value more economically.

The reduction in water content is accomplished without the aid of a filter press or other supplementary purifying equipment. The filter press is used only to remove colloidal carbon from circuit breaker oil.

DE LAVAL

INSULATING OIL PURIFIERS

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

MANUFACTURERS & MARKETS

"HOT LINE" demonstration by the A. B. Chance Co "hot line" unit before a group of Canadian utility engineers

A. B. Chance 'Hot Line' Unit Tours Eastern Canada

Eastern Canadian utilities, both public and private, today have a new viewpoint of the possibilities of live-line maintenance. They got it during the recent tour of the A. B. Chance Co "hot line" display and demonstration unit. Though in some areas handling "hot lines" was done occasionally, it was an entirely new practice in others. As a result, many newspapers carried pictures and stories of the demonstrations and of the tools used.

All of the A. B. Chance line of tools was used. Demonstrations consisted of using these tools on various jobs commonly encountered on the host system.

Demonstrations were conducted at Toronto, Ottawa, Montreal, Three Rivers, Quebec, Halifax, and St. John, N. B.

O. G. Anderson, A. B. Chance demonstrator, and W. H. White, Canadian Line Materials, arranged the tour.

•

See Big Washer Sales

Bendix Home Appliance, Inc, expects 1947 sales of Bendix washing machines will amount to $151.6 million retail. In unit sales, this would be 616,650 washers, 15.1 percent of the industry total, W. F. Linville, sales manager of Bendix, stated. The figures are based on the industry's production rate to Oct 1. Mr Linville said he regarded this year's high sales as abnormal due to pent-up demand and foresaw 1948 sales of 3 million to 3.5 million units based on national income payments to individuals of $194 billion.

•

Fiberglas Textile Activities to Be Centralized in East

Two moves to centralize fiberglas textile work in the East, nearer the textile industry, have been announced by Owens-Corning Fiberglas Corp, Toledo. A fiberglas textile division will be established in New York City at 16 East 56th St, staffed largely by personnel from the Fiberglas Yarns Division of the company's general offices in Toledo.

The fiberglas textile product development laboratory will be transferred from the Newark, Ohio, plant to the plant in Ashton, R. I., with laboratory operations to start shortly after the first of the year. Basic research will continue at the general laboratories in Newark, while the Ashton unit will work with weaving mills and cloth processors.

New GE Process Speeds Making of Small Motors

A close study of the materials and methods used in the manufacture of fractional-horsepower motors and generators at the Fort Wayne Works of the General Electric Co is resulting in new manufacturing techniques which are quickening production.

One innovation now in use is a means of assembling permanent magnets in rotating machines without the need of grinding the pole faces, a costly and time-consuming process. After being cast as close to size and shape as possible, the magnet is assembled between soft steel parts that can be machined to maintain over-all dimensions. The air gaps between the steel parts and the permanent magnet cast surfaces are filled with iron powder and a supporting cement. A thermal setting cement is used as a carrier for the iron powder and is not intended to provide mechanical support for the pole faces.

This construction is being used on several fractional-horsepower permanent magnet d-c generator stators and may soon be applied on alternators having rotors of similar construction.

•

Acquisition of Durite Announced by Borden Co

Aquisition of Durite Plastics, Inc, Philadelphia, by The Borden Co has been announced by Borden Vice-President William F. Leicester. The transaction involves an exchange of stock valued at approximately $3,000,000.

The new acquisition will be known as the Durite Plastics Division of the Borden Co. Emil E. Novotny, president of Durite and well known in the industrial field for his development of many important patents, will continue to direct the activities of Durite. Other executive and operating personnel will remain unchanged, Mr Leicester said.

Under the terms of the agreement, Borden's has purchased the Durite office and plant facilities at 5000 Summerdale Ave in Philadelphia. This includes 18 buildings on a 13-acre tract of land and additional laboratory space.

Durite has been in the synthetic resin field since 1916 and Borden since 1936.

"I've always been a part of your telephone service"

"You'll find my name on your Bell telephone —you see it on reels of cable being fed into manholes or strung on poles—you'll find it, too, on the complex equipment in your telephone exchange.

"As the supply member of the Bell Telephone team, I manufacture equipment, purchase supplies, distribute both to the telephone companies, and install central office equipment.

"Year in, year out, I help my Bell Telephone teammates to give you the world's *best* telephone service at the *lowest possible cost.*

"Remember my name—it's Western Electric."

MANUFACTURER... of 43,000 varieties of telephone apparatus.

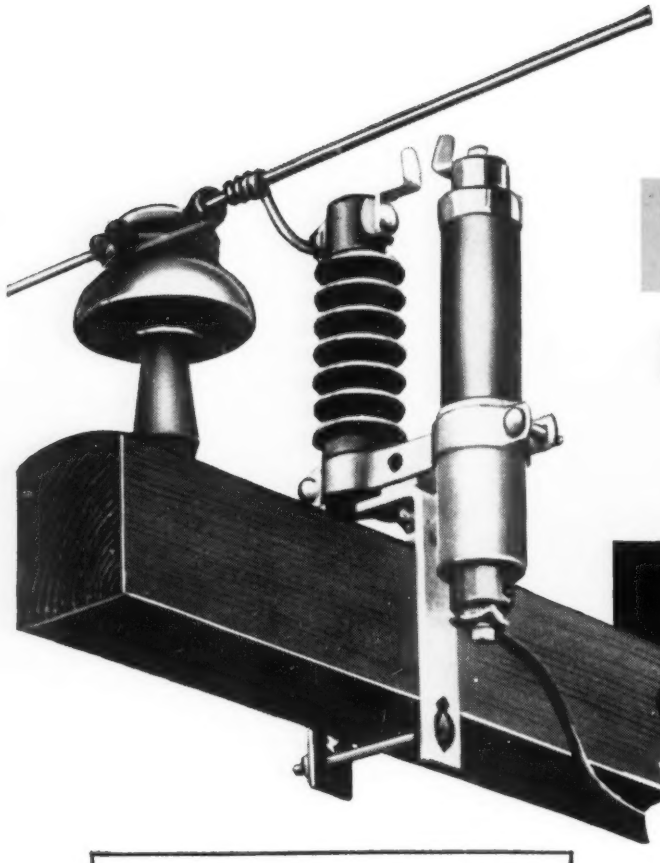
PURCHASER... of supplies of all kinds for telephone companies.

DISTRIBUTOR... of telephone apparatus and supplies.

INSTALLER... of telephone central office equipment.

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882



HI-STROKE RURAL ARRESTER

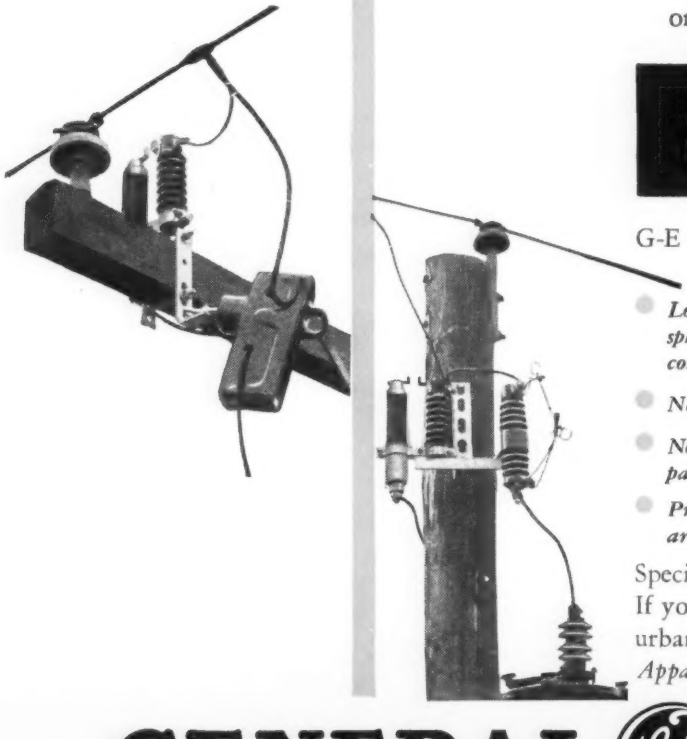
has performance efficiency heretofore unavailable in expulsion arresters

DESIGNED ESPECIALLY FOR RURAL SYSTEMS — 6-kv rating for 4800-volt circuits, 9-kv rating for 7200, 7200/12470 volt grd Y circuits.

ABOVE: 9-kv Hi-Stroke arrester, showing separate clamp-type mounting on crossarm.

BELOW: Hi-Stroke arrester can be mounted in combination with enclosed or open-type fuse cutouts, on crossarms or direct to pole.

The Hi-Stroke rural distribution arrester has exceptionally low impulse sparkover level, unsurpassed by any expulsion-type arrester—providing protection which closely approaches that of efficient valve-type arresters. AIEE and ASA standard impulse tests demonstrate the large margin of protection to either new or old transformers. Hi-Stroke arresters, both on Type HBA rural transformers and mounted separately, have already established a practically perfect operating record of protection and endurance to severe lightning-stroke currents on badly exposed rural lines.



. . . has EXCLUSIVE CONSTRUCTION FEATURES for longer life and utmost reliability.

G-E Hi-Stroke distribution arresters are the *only* expulsion-type arresters having *all* these features:

- ***Longer service life. Reserve supply of gas-evolving material {celofiber spheres} is automatically fed into arc-interrupting chamber to compensate for erosion during discharge.***
- ***Negligible arc flame during expulsion action.***
- ***No possibility of leakage current through arrester element because live parts are mounted on separate post insulator.***
- ***Prevention of line lockouts, because the line lead is supported separately from arrester element.***

Specify your Hi-Stroke rural arresters from Bulletin GEA-4582. If you prefer valve-type arresters, suitable for either rural or urban service, specify Pellet arresters from Bulletin GEA-2975. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

405-26